Pre-Contract Negotiation of Technical Matters

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FOREWORD

This publication is one of a number which describe various aspects of the constantly self-improving, very flexible manufacturing system developed by Ishikawajima-Harima Heavy Industries Co., Ltd. (IHI) of Japan. Other such publications describe how work is organized in accordance with the principles of Group Technology so that parts and subassemblies of many different types needed in varying quantities we classed by the problems inherent in their manufacture and processed on dedicated, highly efficient real and virtual production lines controlled by statistical methods. Another publication describes how through great interaction of highly professional production engineers with designers, a build strategy is documented in time to guide development of all design phases specifically including contract design. The beneficial consequence is efficient, highly-organized work to produce contrived parts and subassemblies, even of unprecedented designs.

"We could be just as productive," say traditional shipbuilders, "if we built only standard series ships but U.S. owners impose different requirements and preferences." Equally misleading they add, "Japanese shipbuilders will not accept change orders." "Not so!" says this publication which describes a tremendous pre-contract negotiation effort, as a significant part of a modem Japanese shipbuilding system, to specifically identify owners' different requirements and preferences *before contract award.* That is, the pre-contract effort is so exhaustive that there is, instead, little prospect for change. With rare exception, owner's peculiar requirements and preferences are accommodated beforehand allowing the building program to be rapidly executed without vacillation, to the benefit of both parties.

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This publication was produced for the Los Angeles Division of Todd Pacific Shipyards Corporation by L.D. Chirillo Associates of Bellevue, Washington.

The material on which the contents are based was compiled by a project team directed by Y. Ichinose of IHI Marine Technology, Inc., New York City. Y. Mikami and A. Itoh, both of IHI International, served as Associate Director and Project Manager respectively. Advisors to many unnamed IHI contributors were K. Motozuna, M. Kuriki and K. Nagayama all of Ishikawajima-Harima Heavy Industries Co., Ltd. (IHI) of Japan. Editing and some supplemental writing was performed by L.D. Chirillo assisted by R.D. Chirillo.

Special appreciation is expressed to the nine ship owners who responded to questionnaires which were part of this project. Their constructive submittals are interpreted as encouragement for shipbuilders to highly develop capabtities for pre-contract negotiations of technical matters. Appreciation is expressed to the fifteen shipbuilders, truly representative of the entire U.S. shipbuilding industry, who also responded. As confidentiality was assured, specific acknowledgements of the cooperating owners and shipbuilders are omitted.

Appreciation is also expressed to T. Lamoureux and L. Willets of Todd's Naval Technology and Los Angeles Divisions respectively, who furnished essential support.

This publication is an end product of one of the many projects managed and cost shared by Todd for the National Shipbuilding Research Program. The Program is a cooperative effort by the Maritime Administration's Office of Advanced Ship Development and the U.S. shipbuilding industry. The objective, described by Panel SP-2 of the Ship Production Committee of the Society of Naval Architects and Marine Engineers, is to improve productivity.

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1.0 INTRODUCTION

1.1 Background and Task Objectives

Many U.S. shipbuilders and owners experience problems with each other particularly during design and production phases. Usually, most shipbuilder troubles stem from the following:

- Changes due to poor design/engineering-capability and/or insufficient clarification of technical matters with customers before contract award.

- Conflicts with owners' representatives during production due to lack of prior discussions, negotiation and agreement before contract award concerning: design and production practices, inspection acceptance levels, authority of owners' representatives and selection of materials as well as of machinery suppliers.

Such conflicts are causing substantial losses to both parties. Representatives of an owner noted that "...nowhere else in the world is a great percentage of the construction cost of a vessel allocated to legal fees, accounting procedures and associated personnel." [1] Such losses could be avoided if thorough discussions and agreements characterized precontract negotiations in the U.S.

In order to avoid conflicts, the purpose of this publication is to provide guidance concerning technical items that should be clarified and/or incorporated in contract specifications. Obviously, when conflicts are avoided, a ship's cost is reduced and both owner and shipbuilder benefit.

1.2 Approach

In order to identify problems which are due to lack of clarification during. pre-contract negotiations, the approach for preparing this publication featured:

- Identification of technical matters that should be discussed and clarified during precontract negotiations. (All items considered to be "theoretically" necessary were listed. Actual items deemed to be caused by lack of clarification during negotiations, were sorted, analyzed and also included.)

- Identification of pertinent problems experienced by U.S. shipbuilders and/or owners. (Questionnaires were distributed to a selected number of shipyards and owners. Replies were analyzed, compiled and plotted as statistical graphs which depict the causes and/or substances of the problems, both qualitatively and quantitatively.)

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[1] J.W. Boylston, W.G. Leback, "Toward Responsible Shipbuilding," Transactions, SNAME, 1975.

With the data so obtained, researchers visited several shipyards and owners in order to discuss their responses in more detail. Thus, this publication which is based upon methodology generally applied by Ishikawajima-Harima Heavy Industries, Co., Ltd. (IHI) of Japan, also reflects opinions of U.S. shipbuilders and ship owners.

1.3 Troubles Experienced During Construction in U.S. Shipyards

Questionnaires were sent to 15 shipyards and to 25 owners. Ten shipbuilders and 9 owners responded. The questionnaires and answer summaries are in Appendix A.

The questions were designed to provide contrasting views concerning the sources of conflicts. The following response summary identifies causes of problems actually experienced:

1.3.1 Problems

Question: What kind of matters did the problems relate to?

Top Five Answers:

Rank	Shipyard	Owner
1	Engineering or Design	Engineering or Design
2	Inspection	Quality of Workmanship
3	Approval Procedures	Painting
4	Painting	Shipyard Practice
5	Shipyard Practice	Inspection

Comments:

Both claim that "Engineering or Design" is the top problem area. Evidently, this is attributed to poor engineering or lack of understanding of design features during technical negotiations between shipbuilders and owners.

The second rank provides quite a contrast as shipyards identified "Inspection" while owners blame "Quality of Workmanship." Obviously, they have different quality criteria.

"Painting" and "Shipyard Practice" seem to be regarded equally by shipbuilders and owners.

Question: What was the nature of and "Quality" troubles?

Top Seven Answers:

Rank	Shipyard	Owner
1	Painting	Erection
2	Vendor Drawings	Welding
3	Living Quarters	Piping
4	Piping	Painting
5	Machinery Outfitting	Fabrication
6	Quality of Vendor Material	Machinery Outfitting
7	Fabrication	Assembly

Comments:

Common “Practice” and “Quality” troubles relate to “Painting”, “Piping” and “Machinery Outfitting”. As shipbuilders and owners are recognizing the same problem areas, such hassles could be prevented rather easily by intensifying exchange of information and data beforehand.

Shipbuilders complain about poor or delayed vendor-drawings and poor quality of vendor-supplied machinery or other materials. Because of such deficiencies, shipbuilders experience serious problems in design and engineering which are causing design changes and/or adversely impact on design schedules.

1.3.2 Causes

Question: What do you think causes during construction?

Top Five Answers:

Rank	Shipyard	Owner
1	Unexpected Owner Requirement	Poor Production Quality
2	Unexpected Owner Representative Requirement	Poor Quality Control
3	Incomplete Contract Negotiation	Poor Design or Engineering
4	Poor Trouble-Shooting Technique	Incomplete Contract Negotiation
5	Unexpected USCG Requirement	Poor Trouble-Shooting Technique

Comments:

The causes of trouble show significant differences between the two sides. The owners blame “Poor Production Quality”, “Poor Quality Control” and “Poor Design or Engineering”. At the same ranks, shipyards are focusing on unexpected requirements from owners and their representatives in the field as major causes of troubles. Significantly, both admit that “Incomplete Contract Negotiation” is also a major cause. Both appreciate the need for more intensive contract negotiations.

1.4 Summary of Interviews

After assimilating the answers to the questionnaires, the researchers visited three shipyards, two owners and one independent design firm in order to obtain details about problems reported. The results, categorized by major causes of trouble, are as follows:

1.4.1 Troubles Caused by Owner Furnished Drawings

Examples of problems experienced by a shipyard which ranked "Engineering or Design” first in response to the question “What kind of matters were the troubles related to?”, are:

Example No. 1:

Owner-furnished hull lines and propeller drawings were modified by a shipyard. During sea trials there was unacceptable vibration.

Example No. 2:

Regarding certain fittings, an owner insisted on more elaborate design details and better quality than was indicated on a guidance plan furnished by the owner as part of the contract.

In both cases the shipyard was confronted with a hold-harmless clause in the contract which, being a generality rather than a true specification, stipulated that, "The Contractor shall be responsible for the construction, using good shipbuilding practice, of a complete and seaworthy ship."

Such troubles raise the question of "liability" of the design drawings supplied by an owner or owner's design agent. Normally, design agents do not warrant or assume responsibility for any expenses for damages originating from design. In most cases, a shipyard is forced to concede and bear the burden regardless of responsibility. To avoid problems originating from owner-furnished drawings, a shipyard should have a lawyer draft for inclusion in contracts a statement to the following effect:

> "Any defects or errors discovered in owner-furnished drawings shall be solved by taking appropriate measures upon consent by both parties. The Contractor (shipyard) shall not assume responsibility nor bear the expenses incurred in any damages or rework, etc., originating from the defects or errors in owner-furnished drawings."

1.4.2 Troubles Related to Owners' Inspectors

Some examples of problems experienced by shipbuilders that are due to field inspectors who represent owners, are:

Example No. 1:

A hull block was inspected and approved by one inspector in a shop during a scheduled period allowed for inspection immediately following block completion. Later, the same block was rejected by another inspector at the building berth during hull erection.

Inspections by several different people are apt to cause inconsistency and conflicts in judging quality or workmanship. Each inspector employs to some extent, unique criteria for judging quality. For example, removal of minor items which do not affect hull structure, such as lugs and padeyes used in building processes, may be of no concern to the first inspector. Yet, a second inspector at the building site may insist on their removal although scaffolding is then required and costs for the same work are significantly increased.

Example No. 2:

A piping and valve arrangement had to be relocated to satisfy a requirement for accessibility and maintenance as determined by a ship's engineer who arrived in the yard before his ship was delivered. The arrangement had been previously approved by one of the owner's inspectors who judged that there were no operability or maintainability problems. Yet, the shipyard had to rework the arrangement on board at great expense, as the requirement from the ship's engineer prevailed. This is a typical example of inconsistency in judgement between individuals. To avoid such problems, an owner's chief representative stationed in a shipyard should have authority to consolidate requirements raised by all other of the owner's representatives and should present for accomplishment only those considered necessary to meet the requirements of the contract plans and specifications.

Another shipbuilder complained that one owner had more than ten inspectors stationed in the yard during the whole production period. Also, this rather permanent group was supplemented by one or two specialists having very parochial concerns who arrived periodically. All were loosely organized. As a result, inspectors individually listed their requirements and randomly presented them to various shipyard personnel without having them screened by the owner's chief inspector who was responsible for selecting the items to be executed.

Much confusion was caused in production because the various inspectors were submitting inconsistent requirements. The matter became worse when the ship's crew joined the inspection team just before ship delivery creating rework under on-board, adverse conditions with great potential for disrupting the scheduled delivery date and schedules for other ships being constructed. Such problems could have been avoided if the owner's chief representative had greater control over his assistants and the ship's crew.

On the other hand, owners assign many inspectors when they do not trust a shipyard's quality and workmanship. Shipbuilders can establish such trust with effective systems for statistical control of quality and accuracy. Statistical evidence of how a shipbuilding system performs, presented during precontract negotiations, will assure a knowledgeable owner that less inspection is justified and the consequences will be improved quality and productivity from which both parties will benefit.

Also, just as much as some ownerts chief representatives do not coordinate the activities of their inspectors, within some shipyards there are inadequate management systems for decisive processing of reports by owners' inspectors. Petty squabbles sometimes erupt because a weak shipyard manager avoids resolving responsibility conflicts, such as between engineers and contract administrators, or because designers "take too long to study the problem and propose expensive fixes." Production people often then barge ahead with fixes of some sort without knowledge of possible consequences or without recording costs specifically due to such rework.

The only solution is assignment of a single shipyard authority to consolidate owner reports of unsatisfactory features and to respond in accordance with a single shipyard policy.

1.4.3 Other Problems Experienced by Shipyards

- There are insufficient quality and inspection standards particularly for accuracy in hull structure and for painting. Typical such documents, excerpts are in Appendix B, which avoid many conflicts between owners and Japanese shipbuilders are:

- Japanese Shipbuilding Quality Standard - Hull Part (JSQS) which is published by The Society of Naval Architects of Japan for the benefit of all Japanese shipyards. The statistically derived contents describe the normal accuracies for common structural details achieved by the shipbuilding industry. Thus it is not conceived arbitrarily or by consensus. As it reflects what the industry does normally with normal shipyard where withal, the publication is referenced in contracts so as to avoid owner/shipbuilder disputes concerning structural accuracy. [2]

- Shipbuilding Process and Inspection Standard (SPAIS) which is published by IHI for the benefit of IHI shipyards and which is referenced in contracts.

- Quality and Inspection Standard for Ships Painting (QISSP) which is published by IHI for the benefit of IHI shipyards. Although some written description is included, the publication consists mostly of perfectly reproduced color plates that clearly show differences in the various degrees of surface preparation that owners and IHI shipbuilders discuss during precontract negotiations and ultimately reference in contracts.

o Contract specifications based on standard specifications published by the Maritime Administration (MarAd), are too detailed. Little room is left to provide alternatives.

o The scope of approval plans are too extensive.

o In some cases owner's options are too extensive. For example, one contract included an owner option to change the propulsion system from "steam" to "diesel". Reportedly, the shipyard had to prepare two designs pending the owner's selection.

o Brand names accompanied by "or equal" are defacto specifications for the brand names. Shipyards have difficulty in negotiating prices with such suppliers. Eventually, the shipyard pays higher prices as owners' preferences usually prevail.

o There is inadequate communication between shipyards' design and production functions. In the absence of a documented build strategy prepared and continually refined by production engineers, production requirements are neglected in contract design and subsequent design phases.

[2] A project to so collect, combine and publish structural accuracies normally achieved by U.S. shipbuilders, is to be implemented by the National Shipbuilding Research Program with a schedule start early in 1985.

2.0 BASIC OBJECTIVES AND STRATEGIES OF PRE-CONTRACT NEGOTIATIONS

2.1 Objectives

The traditional objective of pre-contract negotiation is to only define a vessel's performance, material quality and functional requirements of machinery systems and equipment. However, these definitions establish the bases of material costs, but not necessarily labor costs. The latter are normally based upon a shipyard's normal practices, production processes, quality of workmanship, etc., which could be easily affected by non-standard owner requirements.

Defining the factors which are peculiar to a shipyard during pre-contract negotiations is equally important. They must be reflected in the specification requirements and contract price ultimately negotiated. In other words, for modern shipbuilding systems, the primary objective of pre-contract negotiation also includes obtaining clear mutual understanding of how the ship is going to be built, and what quality and workmanship is assured by the shipyard.

The efforts for such definition may not be necessary for long-time customers who are quite familiar with a shipyard's practices. For instance, a ship built in the past by a yard could be selected as criteria for a ship to be built. But even then, conflicts may occur if there are significant changes in immediately assigned owner and shipyard personnel or if the ship's nature or quality requirements are really quite different from the one previously built.

Of course, more prudence is required when dealing with first-time customers who have no experience with or knowledge of the yard. By clarifying how a ship is going to be built, and what quality and workmanship is assured by the shipyard during pre-contract negotiations, unexpected requirements after contract award are minimized.

The understandings and/or agreements reached during pre-contract negotiations should be documented in the contract or in the contract specifications or attached as memoranda to either one. Otherwise, there will be no evidence of understandings even though the matters had been thoroughly discussed and agreed upon between the two parties.

2.2 Importance of Pre-Contract Negotiation

2.2.1 General

Pre-contract negotiations are quite time consuming if all engineering and production matters are to be addressed. However, both a shipbuilder and owner must be patient enough to spend the time required to clarify ambiguities in proposed contract plans and specifications that could generate serious conflicts in the future.

Questionnaire responses confirmed that such troubles mostly occur late in the overall process as a ship is being constructed on a building berth. The later problems occur, the costlier they are to solve.

A drawback of traditional contract plans and specifications is that they are design- rather than production-oriented. This is due to the fact that most are prepared by an owner or owner's design agent for bidding purposes. Therefore, the absence of production requirements in such plans and specifications should be expected.

A shipyard is responsible to examine proposed contract plans and specifications from a production standpoint as well as engineering's and to propose modifications and/or additions in order to include production's build strategy and other needs during pre-contract negotiations. Needless to say, such considerations should be thoroughly discussed and settled before fixing a contract price and before including them in appropriate contract documents. Further, a shipbuilder cannot effectively negotiate without a professional production-engineering capability to formally document a build strategy and other production requirements before negotiations start.

In some cases, shipbuilders defer such negotiations to a post-contract stage merely to expedite signing contracts. Obviously, such practice is risky as it is much easier to solve problems before contract award where the absence of a ship's price allows more freedom to negotiate.

2.2.2 Contract Plans

Not all U.S. shipyards have sufficient engineering capability to prepare contract plans and specifications. Traditionally, contract plans are furnished by an owner's technical department or design agent, mainly for bidding purposes. Accordingly, such documents only define functional requirements and disregard producibility considerations.

In contrast, most Japanese shipyards have powerful basic-design capabilities in order to design and produce any ship from scratch. Thus, they are able to treat basic or contract design as part of a shipbuilding process. They readily incorporate a build strategy and production practices and standards as means for preventing conflicts particularly during construction.

A shipyard's basic design capability affects the character of contract design. In modern shipbuilding systems, basic design assimilates production-engineering inputs and produces a product-oriented contract design, i.e., one that fully protects a shipyard's production policies.

Therefore, a shipyard must foster or control a competent basic design function which can participate in negotiations in order to insure that the yard's production concerns are incorporated in proposed contract documents prepared by an owner or owner's design agent. Ideally, a shipyard would have the capability to both design a ship to meet a prospective owner's basic requirements and to produce the contract plans and specifications in-house.

However, if a shipyard has capable production engineers who can devise, formally document and convey a build strategy and other pertinent production concerns, the shipyard's employment of a design agent to function as a basic-design capability and to participate in behalf of the shipbuilder in negotiating a contract design, could also be effective. In short, the major need is for production engineers who are able to adequately communicate with designers regardless of where the latter are located.

Basic or contract design is part of the shipbuilding process in modern shipbuilding systems.

If a shipyard has or controls such capability, an owner would only have to provide a conceptual specification which addresses basic characteristics while deferring preparation of contract plans to the shipyard. This approach permits a shipyard ideal freedom to incorporate production-engineering matters while, at the same time, satisfying owner requirements.

Obviously, an owner and a shipbuilder would have to elect some way, a letter of intent perhaps, to encourage their negotiation of a mutually-satisfactory contract design. Sophisticated owners have pertinent experience and at least one has successfully completed such negotiations with two U.S. shipyards as of September 1984.

In order to expedite preparation of contract specifications, a shipyard should establish standard specifications for each type of ship which the shipyard intends to construct, e.g., tanker, bulk carrier, container ship, etc.

MarAd standard specifications could provide a suitable format but should be expanded to include production practices and standards that a shipyard will actually apply. However, shipbuilders made many complaints regarding the contents of MarAd standard specifications which are no longer mandatory but, in the absence of other such compilations, influence traditional preparation of shipbuilding specifications. Proposed changes and reasons therefore, to adapt MarAd standard specifications as shipyard standard specifications, are presented in Appendix C.

The scope of contract plans and guidance drawings required if MarAd standard specifications are invoked, is too extensive. For example, most Japanese shipyards employ only contract specifications and a general arrangement. Production practices and inspection standards are only invoked when a shipyard and owner are not familiar with each other.

Although other plans are discussed with an owner during pre-contract negotiations, e.g., preliminary midship section, machinery arrangement, piping diagrams, electric-load analysis, electric one-line diagrams and hull/machinery/electric back-up calculations, they are not usually included in a contract package. If mutual understanding has been reached on such preliminary drawings during pre-contract negotiations, there is no necessity to include them as contract plans.

2.3 Items to be Discussed During Pre-Contract Negotiations

If contract plans and specifications were prepared by an owner or owner's design agent, a shipyard should spend sufficient time to review them from both design and production viewpoints. Reviews by production engineers are especially necessary to identify items which will not meet their production practices or facilities. Such items should be listed in priority order together with proposed solutions so that they may be efficiently discussed during pre-contract negotiations.

Another practical procedure is to have a standard check list which identifies major design and production items that should always be discussed with prospective owners.

Pre-contract negotiations should first address general matters so that they are clarified before entering into discussions concerning details. The following are some of the major items which should be addressed on a priority basis during the initial discussion stage:

2.3.1 General

- Applicable rules, regulations, etc.
- Owner's plan-approval procedures, scope of approval drawings, authority of owner's representatives/superintendents to be stationed in the shipyard, design changes, cost adjustments, etc.
- Building strategy and methods, production processes (i.e., hull-block construction, zone outfitting, zone painting), inspection and accuracy standards, painting systems, etc.
- Significance of statistical control methods and schedule adherence to both owner and shipbuilder.
- Vendors/suppliers of major machinery and equipment.
- Guarantee items, e.g., deadweight speed, fuel consumption, and delivery.
- Sea trials, testing, etc.

2.3.2 Hull

- Principal hull particulars with backup calculations, i.e., trim and stability calculations, speed-power calculations, etc.
- General arrangement including cargo hold/tank arrangement and cabin arrangement.
- Cargo loading/unloading systems such as:

  - for tankers, cargo pumps and cargo piping system;
  - for dry-cargo ships: cargo gear (derricks, deck cranes, etc.).

- Bases for structural design, i.e., scantling draft, heavy-cargo loading, alternate-hold loading, ice strengthening, double-bottom reinforcement for grab-bucket handling, deck reinforcement for deck cargo, fork lifts, vehicles, etc.
- Bases for design of hull systems, machinery and equipment, i.e., heat, ventilation and air conditioning; mooring, reefer stores, cargo hatches, cargo winches/gear, fire fighting, etc.
- Major hull-piping diagrams.
- Special equipment/systems, i.e., container-cell guides/fittings, etc.

2.3.3 Machinery

- Principal-machinery particulars with backup calculations, i.e., heat balance, etc.
- Bases for design of machinery systems.
- Machinery arrangement.
- Main-engine and ancillary systems.

  Piping diagrams for machinery systems.
- Bases for shafting and propeller designs.

  Engine-room automation systems and main-engine remote-control system.
- Workshop/storeroom arrangements.

2.3.4 Electrical

- Principal electrical-particulars with backup calculations, i.e., electric-load analysis, etc.
- Bases for design of electrical systems.
- One-line electric wiring diagrams.
- Arrangement of electrical equipment.
- Control console in engine-control room.
- Bridge console.
- Switchboard, group starter panels, etc.
- Navigation equipment.
- Wireless equipment.

In order to facilitate discussion, the specifications should be organized so that a description of each ship-system can be read in a single chapter or section instead of having to refer to various parts of the specifications. Also, general matters should be written in the beginning of a chapter with detailed descriptions following.

Appendix D contains the table of contents for a typical Japanese shipyard's standard specifications for tankers.

Building methods, production processes, inspection/testing standards, etc., are usually not detailed in a specification but, instead, are organized as separate booklets, and are invoked as necessary by reference in the contract. Typical such documents are:

- "Japanese Quality Standards - Hull Part (JSQS) 1982" published by the Research Committee on Steel Shipbuilding, The Society of Naval Architects of Japan.

- "Shipbuilding Process and Inspection Standards (SPAIS)" issued by IHI.

- "Quality and Inspection Standards for Ships Painting (QISSP)" issued by IHI.

Excerpts are included in Appendix B.

3.0 TECHNICAL MATTERS TO BE CLARIFIED

3.1 General

As mentioned in the previous chapters, owners' and shipbuilders' interpretations of specification requirements often differ. Quality criteria, such as workmanship acceptance-levels, surface treatment for painting, welding, etc., are in many cases quite difficult to define and sometimes must depend on personal determininations. Naturally, there are conflicts. Therefore, thorough discussions are essential to arrive at understanding of each other's intentions, ideas and concerns, so that common criteria which is satisfactory to both parties may be established.

Specification descriptions should be sufficient enough to define required functions, performances and quality levels. Descriptions that are too vague will cause different interpretations while descriptions that are too detailed will restrict a shipyard's freedom to select equivalent alternatives. Also, a shipyard's responsibility should be clearly defined so that it is protected from irrational and unrealistic claims.

Before entering into contract negotiations, a shipyard must fully examine and digest requirements and meanings of proposed contract plans and specifications, especially those proposed by an owner or owner's design agent.

Problems should be listed in priority order together with proposed solutions. Review by production engineers as well as engineering people is essential in order to incorporate a building strategy that best suits a shipyard's normal processes. Responsible production personnel should participate in pre-contract negotiations.

Standards which are intended to be used for design, materials, production, inspection, testing, etc., should be prepared for presentation during negotiations. An owner's understanding of production processes and configurations of standard products, is greatly facilitated when a shipyard employs visual aids.

Check lists should be employed to ensure that no major item which requires clarification, is overlooked.

Generally, a contract specification consists of general provisions and hull, machinery and electrical specifications. The latter provide specific requirements for each non-general category. As the U.S. Maritime Administration Standard Specification for Slow Speed Diesel Merchant Ship Construction is so organized and generally serves as the pattern which U.S. owners, design firms and shipbuilders employ, it will be used as a basis for discussion in the following passages which address technical items which should be further clarified. Pertinent references are parenthesized. [1]

3.2 General Provisions (Section 1*)

3.2.1 General Specification Requirements (Article 2)

o Liability of the Shipyard

The legal liability of a shipbuilder to correct errors and/or defects in engineering, materials and product quality is always a conflicting issue between a shipbuilder and an owner, especially when the contract plans and specifications are furnished by an owner or owner's design agent. Some examples are described in Part 1.4.1.

Although a shipyard shares responsibility to detect and correct such errors before contract award, there are some errors that cannot be discovered until some degree of detail design is accomplished. As a shipyard should have protection from bearing the expense of such errors, as stated previously and repeated for emphasis, a lawyer should be retained to draft for inclusion in contracts a statement to the following effect:

"Any defects or errors discovered in owner-furnished drawings shall be solved by taking appropriate measures upon consent by both parties. The Contractor (shipyard) shall not assume responsibility nor bear the expenses incurred in any damages or rework, etc., originating from the defects or errors in owner-furnished drawings."

o Shipbuilding Practice, Quality Standards

Quality of workmanship is most difficult to define. Conflicts during inspection by an owner's representative, such as those described in Part 1.4.2 are troublesome if there are no pre-established quality standards or criteria. Quality standards such as JSQS (see Appendix B) which are derived analytically from statistical control methods in order to describe how work processes normally perform throughout a shipbuilding industry, are necessary and should be invoked in contract specifications or otherwise made part of the contract by reference.

3.2.2 Principal Characteristics (Article 3)

If a shipyard proposes a basic design for a ship requirement, the shipyard should also present principal characteristics with supporting data such as trim and stability calculations, speed-power analysis, etc. in order to provide assurances to a prospective owner. In addition, a shipbuilder should supplement description of principal characteristics in a specification with a ship's general description such as the following:

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[1] Standard Specification for Slow Speed Diesel Merchant Ship Construction dated June 1980. Many of the hull sections listed in the Table of Contents do not appear in the body of the specifications. Instead, reference is made to the U.S. Maritime Standard Specifications for Merchant Ship Construction dated January 1979, which was developed primarily for steam propulsion plants. Herein, an asterisk (*) denotes such references.

"The vessel shall be designed and constructed as a single screw, diesel driven, bulk carrier with the machinery space and all accommodations including the navigation bridge, located aft."

"The vessel shall have a single continuous freeboard deck with a detached forecastle, and six (6) tiers of deck house situated on the aft upper deck, and shall have a bulbous bow, raked stem and transom stern."

"The vessel shall satisfy one compartment damage stability."

"The hull under the upper deck shall be divided by watertight bulkheads to form the following compartments:

Fore peak tank

Six (6) dry-cargo holds

Engine room

Aft peak tank"

"Detail arrangement shall be in accordance with the General Arrangement Plan."

"Cargo holds shall be constructed as single hull with hopper-sided double-bottom and top side-tanks as shown on the General Arrangement Plan."

"Side hoppers shall have a slope of approximately 45 degrees and the top side-tanks shall have a bottom slope of approximately 30 degrees, both against the horizontal plane."

"The vessel shall be capable of loading cargo in the following conditions:

1) Dry homogeneous cargo in all cargo holds.

2) Ore homogeneous cargo in Nos. 1. 2, 4 and 6 cargo holds and the other cargo holds empty.

3) Grain Cargo with one slack hold without any grain shifting boards."

"No. 4 cargo hold shall be used either as a dry cargo hold or water ballast tank (full or empty)."

"Cargo shall not be loaded in top side-tanks."

"Cargo gear to be fitted."

3.2.3 Laws, Classification, Rules and Regulations (Article 5)

o Effective Dates of Laws, Classification Rules and Regulations

Usually, pertinent laws, classification rules and regulations effective at the date of contract, are the bases of a ship's contract price. However, if an owner wishes to apply any revision in the laws, classification rules or regulations which becomes effective after the final bidding date or the contract date, a shipyard should treat such a request as a "change of contract". The shipyard should then submit a quotation to the owner stating the cost difference to make the change and the affects on the ship's characteristics (i.e., deadweight, speed, etc.) and/or on guarantee clauses such as for ship's delivery.

Further, shipbuilders should retain the right to reject such requests unless the owner accepts the shipyard's pertinent quotations. This right should be clearly stated in each shipbuilding contract or in associated contract specifications with words having the following effect:

"Anything not mentioned in these specifications but required by the Classification Society or Regulatory Bodies listed herein, and as effective at the date of **, shall be supplied and/or equipped by the Contractor. Any changes and/or modification of Regulatory Bodies' rules effective after **, shall be treated as a change to the Contract, and the ship's price, characteristics, guarantee terms, etc., if affected, shall be adjusted accordingly." (** designates final bidding date or contract date, whichever is the case.)

o Certification

Some problems occur when a ship is to be registered in foreign countries, e.g., Panama and Liberia, and built to rules which are different from those which apply to U.S. registered ships. Regardless, some owners may require application of U.S. rules and regulations "just as design criteria" while others may want rigid adherence in order to maintain "reflagging", i.e., changing from foreign to U.S. registration, an easy to accomplish post-delivery option.

Usually, the former case does, not require strict application of U.S. rules nor U.S. Coast Guard (USCG) approved equipment such as for life saving and fire fighting. In the latter case, such equipment requires USCG certificates. As USCG regulations must be strictly applied when an owner applies for U.S. registration, a shipyard should confirm pertinent owner-intentions during pre-contract negotiations.

3.2.4 Plans (Article 6)

Unless absolutely required, the scope of contract plans and guidance plans attached to a contract should be minimized. Such proposed plans to be listed in a contract should be carefully discussed regarding their intent during pre-contract negotiations.

If an owner or owner's design agent proposes contract and guidance plans, the shipyard must be sure that principal characteristics or performance of the contemplated ship are sustained especially when speed, deadweight, etc., are to be guaranteed by the shipyard. For example, Hull Lines, Midship Section and Scantling Plans are the key drawihgs that affect a ship's speed, lightship weight, trim, stability, etc. Avoiding these responsibilities unless basic design is performed by the shipyard, is advisable.

If a builder's guarantee is required, the shipyard should during pre-contract negotiations include the affects on price and delivery for the shipyard to confirm the power estimate, lightship weight calculations, etc., to be provided by an owner or owner's design agent.

If business circumstances dictate otherwise and a guarantee is still required, the shipbuilder should at least obtain copies of the pertinent power estimate, lightship weight calculations, etc., prepared by an owner or owner's design agent. Such documents are needed as evidence for protecting the shipyard if related deficiencies are found at ship's completion.

Typically in Japan, contract plans are furnished by shipyards and usually consist only of Ship Specifications and a General Arrangement supplemented by Quality and Inspection Standards which are also regarded as contract plans.

In the Japanese shipbuilding industry, Lines, Midship Section, Machinery Arrangement and other guidance plans, usually regarded as contract plans in the U.S. shipbuilding industry, are only prepared as preliminary plans for pre-contract negotiations to confirm an owner's concept and requirements. Final such plans are submitted to the owner for approval after contract award.

This approach, mutually beneficial to owners and shipyards, saves time and costs associated with preparation of contracts. As detailed engineering is performed based on the latest technical information furnished by material and machinery suppliers, design errors and changes after contract award are minimized.

3.2.5 Weight and Center of Gravity (Article 7)

Usually, submittal of weight and center of gravity calculations are not required in a commercial ship contract. However, if the contract and guidance plans are being furnished by an owner or owner's design agent, the shipyard should request lightship-weight calculations and other necessary back-up data from the owner.

During pre-contract negotiations, lightship weight should be clearly defined because sometimes the definitions used for foreign registration differ from the standard U.S. definition.

3.2.6 Stability and Subdivision (Article 8)

o One Compartment Damage Stability

One compartment damage stability is not normally required for commercial dry-cargo ships. However, when specifically required, basic conditions such as permeability, margin line, list, etc., should be defined in the contract specifications.

o Trim and Stability Calculations

Defining typical ship conditions for trim, stability and longitudinal bending-moment calculations, is advisable. For a commercial cargo ship or oil tanker, the following conditions are normally sufficient:

- Full-load (maximum draft) departure and arrival conditions with homogeneous cargo.

  Heavy ballast (at rough sea), departure and arrival conditions.

  Normal ballast, departure and arrival condition.

  For grain cargo, departure and arrival condition with grain storage factor in accordance with SOLAS requirements.

  For alternate cargo-hold loadings, full-load departure and arrival conditions with cargo holds loaded as designated.

Each of the above may need calculations with fuel and fresh-water tanks fully loaded and partially loaded, depending upon voyage legs.

3.2.7 Model Tests and Ship Performance Predictions (Article 9)

Hydrodynamic, speed and maneuverability analyses can now be obtained with high accuracy through use of computers. Thus, model tests are not always necessary for designing even some high-performance hull forms. Because their computer analysis techniques are proven to be reliable, some shipbuilders have eliminated need for tank testing models. They specifically identify expense for an owner's requirement to tank test a model as an incremental cost added to the ship's price.

One shipbuilding firm having hull numbers up to nearly 3,000, has never had to pay a penalty for not fulfilling guaranteed speed and fuel consumption. Current practice is to rely almost exclusively on computer analyses in lieu of model tests. Further, that firm is willing to perform such analyses for other shipbuilders and to guarantee predicted speed and fuel consumption. Costs in terms of both money and time would be favorable compared to traditional tank testing.

Sometimes an owner does not have confidence in a shipyard's computer obtained predictions and requires model testing as confirmation. If still not satisfied, the owner may ask for modifications in the hull form necessitating additional model testing with the possibility of adverse impact on the shipbuilder's design and production schedules. Thus, such requirements should be thoroughly discussed during pre-contract negotiations. Is the objective to create a hull form or to confirm existing lines? In both cases, the method, computer or tank testing a model, should be decided before contract award.

3.2.8 Vibration and Noise (Article 11)

o Vibration

Vibration acceptance levels are usually vague and can cause conflicts between owners and shipbuilders. There are some acceptance levels for vertical and horizontal readings proposed by Meister, Janeway, Johnson and Ayling; Kumai, Kanazawa, ISO, etc., but these are only suitable as references when a problem occurs. Nonetheless, a shipyard should be prepared with some criteria which are internationally accepted.

For diesel ships in particular, conducting a hull-vibration analysis during basic design is extremely prudent. If unacceptable resonant vibration is likely to occur, appropriate countermeasures could be taken in a timely manner. Remedial efforts following sea trials are usually very costly.

3.2.9 Access for Inspection During Construction (Article 13)

Where zone outfitting and painting of hull blocks is practiced, shipyard procedures should insure that hull-block inspections and outfitting and painting work are scheduled so that they do not interfere with each other. Pipe pieces may be tested following their manufacture in a shop. Also, pipe assemblies are usually tested following on-unit or on-block outfitting. [2]

Final tests of whole systems are made during dock and sea trials. What should be tested and when tests will be made, should be discussed during pre-contract negotiations so that an owner's resident superintendent comprehends a shipyard's test plan and schedule beforehand.

Provision for temporary openings in a hull to provide access to an engine room, etc. during hull construction and outfitting, should also be discussed and agreed upon during pre-contract negotiations.

3.2.10 Inspection (Article 14)

Inspection has been discussed previously and is one of the major causes of owner/shipbuilder arguments.

Questionnaire responses disclose that both owners and shipbuilders consider inspection to be the source of many problems. Where there are no agreeable acceptance standards, such conflicts, often bitter, will continue. Experiences disclose that the most problematic areas are:

o Misalignment of hull structural members, piping, etc.

o Indents on shell, deck and bulkhead plates.

[2] "Unit" designates an assembly of just fittings; no hull structure is represented.

o Welding.

o Surface preparation for painting.

o Removal of: deposits due to weld splatter, temporary pieces from structural assemblies, etc.

o Completion status of hull, outfit and painting work at times scheduled for tests.

Acceptance criteria regarding the foregoing usually differ-between individuals and are difficult to define without authoritative backgrounds. Therefore, acceptance levels or criteria established by institutions, such as classification and professional societies having representation by owners and shipbuilders, are most suitable for arriving at criteria acceptable to all concerned.

The "Japanese Shipbuilding Quality Standard - Hull Part" (JSQS) maintained by The Society of Naval Architects of Japan is even more effective than a traditional standard because it is a compilation of accuracies achieved by the Japanese shipbuilding industry when work is normally applied. JSQS when referenced in contracts becomes the basis for mutual agreement concerning accuracies for many structural details that an owner can expect and that a shipyard can readily achieve with normally-applied methods. Pricing is fixed accordingly based on normalcy.

If for some very special ship, higher orders of accuracy are required, then, JSQS is employed by both parties as the baseline for negotiating costs that will occur due to having to apply specific extraordinary work methods in order to achieve specific increases in accuracy for specific structural details. JSQS is widely used by Japanese shipbuilders, particularly for export ships.

In addition, some shipyards in Japan established their own standards such as IHI's "Shipbuilding Process and Inspection Standards" (SPAIS). Another good example is IHI's "Quality and Inspection Standard for Ships Painting" (QISSP). Because words are not adequate to describe certain conditions, particularly regarding grades of steel-surface preparation for painting, exquisite color photos are incorporated that serve for comparison by an inspector in order to determine acceptance of an actual surface prepared in accordance with a very exacting specification.

As photographs of sufficient quality cannot be reproduced herein, the following captions from IHI's QISSP serve to convey some idea of the fine distinctions in surface-preparation grades that can only be ascertained by managers, workers and inspectors by reference to exquisite photographs:

ISP-A Shot Blast Cleaning - Mill scale has been removed completely, and the remaining traces, after removal of mill scale, are partly visible in the form of spots or stripes.

ISP-B Shot Blast Cleaning - Mill scale has been removed completely, and little remaining traces after removal of rust are visible.

ISC-B Disc Sanding and Power Brushing to Burnt Areas where Long Exposure Wash Primer has been applied. Almost all rust has been removed, and shop primer near the burnt area is changed in color.

ICC-A Disc Sanding and/or Power Brushing to Burnt Areas where Long Exposure Wash Primer has been applied. Rust remaining in pits is visible, and shop primer near the burnt area is changed in color.

Once such standards have been created, they are explained during pre-contract negotiations and attached as contract plans or invoked by the specifications with words having the following effect:

"The vessel shall be built under the survey of the Classification Society, and construction, machinery, outfit and equipment of the vessel shall be inspected and tested as set forth in the Contract, and also in accordance with JSQS, SPAIS and QISSP."

3.2.11 Materials and Workmanship (Article 15)

o Design Conditions

For conventional commercial-ship contracts, stipulating resultant forces due to roll and pitch and due to static trim or list conditions, is not necessary. However, if any stipulation is specifically required, the shipyard should select appropriate figures considering a ship's characteristics.

Other design criteria, such as seawater and air temperatures for cooling systems, cleanliness factor for heat exchangers, margins for propeller design, fluid viscosities, etc. should also be stipulated for design of machinery-systems.

3.2.12 Hull Protection During Outfit Period (Article 16)

When Construction Differential Subsidies (CDS) are not applicable certain requirements, such as hull protection during outfitting, are not mandatory unless specified by an owner. Shipbuilders who have mastered zone-oriented, integrated hull construction, outfitting and painting, achieve nearly complete outfitting and painting at launching and can effect delivery within the two or three months following. Thus, whether there is need for special hull protection between launching and delivery, should be discussed during pre-contract negotiations.

3.2.13 Launching and Dry-Docking (Article 17)

o Dry-Docking

If the period between launching and sea trials exceeds three months, the underwater hull surfaces and propeller could become fouled by barnacles, slime, etc. Dry-docking would then become essential for cleaning to insure that guaranteed speed can be demonstrated during sea trials. Clean hull conditions are also essential for valid comparisons of sea-trial results with model tank-test results and to a propeller design.

3.3 Planning and Scheduling, Plans, Instruction Books, etc. (Section 100)

3.3.1 Approval Plans

Prior to a pre-contract negotiation, a shipyard should prepare a proposed list of plans specifically identified for submittal for approval by the owner, classification society and/or pertinent regulatory bodies.

As compared to practice in Japan, there is a tendency in the U.S. to submit too many plans for approval. Plan approvals should be limited to functional system drawings only. If necessary, they should be annotated with whatever is of special interest to a reviewer.

For example, if the minimim height of an expansion tank is of concern, a note which would specify the minimum height on a system diagrammatic would be sufficient and alleviate having to submit a detailed arrangement which is more difficult to review for the same purpose. Detail yard plans and work-instruction drawings are only required for production purposes and need not be submitted for approval. All parties benefit from such shipyard discernment.

The following is the standard scope of submittals for owner approval when a major Japanese shipyard undertakes construction of a conventional bulk carrier:

o General

- Trim and Stability Calculations with Capacity Tables
- Sea Trial Procedure
- On-Board Test Methods (Hull, Machinery and Electrical)
- Inclining Test and Deadweight Measurement Method

o Hull Construction

Midship Section and Typical Transverse Bulkhead

Construction Profile

Shell Expansion

Welding Scheme

Hull Construction Standards

Main Engine Foundation

Stern Frame

Rudder

- Rudder Carrier

o Hull Outfitting

Mooring Arrangement

Access and Ladder Arrangement

Miscellaneous Outfitting Arrangement

Arrangement of Ship's Name and Marks

Stores Plan

Ventilation Plan

Pumping and Miscellaneous Piping Systems

Piping Diagrams in Accomadation Quarters

Piping Diagram for Fire Fighting System

Hatch Cover Arrangement for Cargo Holds

Air Conditioning System

Refrigerated Provision Store Plan

Joiner Plan

Joiner Works (Lining, Insulation and Deck Covering)

Material Samples for Joiner Work

Life Saving Plan

Painting Schedule

o Machinery

- Machinery Arrangement
- Engine Control Room Arrangement
- Workshop Arrangement
- Engineer/Electric Store Arrangement
- Piping Diagrams (Machinery Part)
- Shafting Arrangement
- Shafting Torsional Vibration Calculation
- Propeller Shaft Extraction Method
- Marking for Piping Systems

o Electrical

- Electric Load Analysis
- Wiring Diagrams
- Arrangement of Electric Equipment
- Practices for Electric Installations
- Engine Control-Console Outline View
- Wheelhouse Operation Stand Outline View
- Main Switchboard Outline View
- Group Starter Panel Outline View

The above listing is acceptable to most owners, internationally. On rare occasions, when justified by complicated ship features, the scope of approval plans has been expanded to include key plans which contain further details.

3.3.2 Vendors/Suppliers Lists

One of the major problems encountered by U.S. shipbuilders concerns timely selection of vendors who are to provide materials including machinery and equipment. Critical time is spent, sometimes months, in selecting a vendor and subsequently obtaining desperately needed vendor-furnished information (VFI) to progress engineering and detail design. Early selection of vendors and availability of VFI is absolutely essential for effective shipbuilding systems.

The most effective Japanese shipbuilders employ files of vendor catalog items which they have pre-approved and elected to call their "standards". For example, for each pump requirement in a machinery arrangement for a particular main-engine model, each of two or three vendors' pumps are listed in the shipyard's file of standards. Although physically different, the pumps have the same functional capabilities. By special agreements with such vendor's, all VFI is maintained up to date in the shipyard's file.

Particularly in a market having a wide product mix, i.e., ships of different designs required in varying quantities including one of a kind, timely arrival of VFI to permit design progress is often more important than timely arrival of the machinery item. Thus, a file of vendor-catalog items treated as standards becomes a powerful competitive edge. In effect, vendors compete twice. First to gain position in a shipyard's file of standards and second to obtain a specific order.

Shipbuilders who maintain files of vendor-catalog items declared as standards do not burden themselves during design when schedule adherence is extremely critical, with preparation of performance specifications and with conducting reviews of vendor proposals. Nor do they burden vendors, during an equally critical time, with requests for proposals that contain many non-technical terms and conditions. As recommended by Dr. W. Edwards Deming, the American known as the father of productivity in Japan, for productivity reasons, such shipbuilders do not deal with an inordinate number of suppliers.

In order to successfully apply a file of vendor-catalog items, shipbuilders have to insure that only good quality items are listed and that resources are invested to keep the file viable. That is, people must be assigned to constantly add newly discovered improved items and to delete items that become obsolete. Such measures, described during pre-contract negotiation, facilitate owner agreement to employ a shipyard's file of vendor-catalog items declared as shipyard standards.

When a shipyard file of such vendor-catalog items does not exist or is not to be used for whatever reason, shipbuilders should discourage the use of a specific vendor name followed by "or equal" in a specification. The practice, intended to specify a level of quality, is defacto proprietary specification which inhibits a shipbuilder from getting best vendor performance considering all pertinent aspects including quality, e.g., effective and timely VFI, delivery, and cost per item. All impact on the entire shipbuilding system and are determinants for fixing a ship's price.

When an owner continues to specify "or equal" for costly machinery items, during pre-contract negotiations the owner should be advised that the shipyard's ability to negotiate with the identified vendors is diminished and higher costs would have to be reflected in the ship's price. Then, shipbuilders should propose that such items be owner-furnished.

As another alternative, shipbuilders should enter pre-contract negotiations with two or three vendor's products that are judged to be equal to each of those specifically identified in an owner proposed specification with the "or equal" proviso. When agreement is reached on a shipbuilder's proposed equals, then following contract award the shipbuilder is free to select vendors expeditiously without further consultations with the owner.

As a generality, U.S. shipbuilders and owners do not appreciate the extreme importance of timely material definition. Japanese managers contradict the Western impression of ideally obedient workers when they say, "In Japan we have to control material because we cannot control people." When dealing with owners, shipbuilders who wish to apply effective shipbuilding systems must convey the same sense of urgency regarding material definition.

3.4 Hull Structure (Sections 2*through 4*)

3.4.1 General Requirements

Basically, structural design is determined by classification society rules and requirements. Consequently, conflicts with owners are rare. However, shipbuilders are responsible to confirm loading conditions required for an intended trade so that hull structures are properly designed to meet such requirements. A classification society does not assume responsibility for any special loading conditions unless the conditions are properly indicated when a shipyard submits a classification application.

3.4.2 Loading Conditions

The loading conditions that affect hull structural design are:

a. Scantling draft and design draft.

b. Ore cargo loading at alternate holds.

c. Loading of heavy cargo (specific gravity and stowage factor).

d. Reinforcement for grab-bucket handling (double bottom).

e. Loading water ballast in cargo holds.

f. Deck reinforcement for lumber, containers, forklifts, heavy deck cargo, etc.

g. Ice strengthening.

h. Combination of cargoes, e.g., ore/oil, ore/bulk/oil, etc.

i. Other special loading conditions.

j. Owner's scantling requirements beyond classification society rules.

3.4.3 Structures Which Require Owner Confirmation

Structures which typically require owners' confirmations are:

a. Type of stern frame and rudder.

b. Stern-frame structure (casting or weldment).

c. Cargo hold/tank bulkhead structure (corrugated or flat).

d. Type of welding inside water/oil storage tanks (continuous or intermittent)

e. Length and depth of bilge keels.

f. Type of cargo-hatch covers (folding, end rolling, side rolling, pontoon, etc.)

g. Use of high-tensile steel (strength and location).

h. Type of gunwale (round or perpendicular)

i. Radius of rounded gunwale (if less than a prescribed minimum, classification rules may require stress relieving after bending).

j. Type of waterway (extension of sheer strake or separate flat bar).

3.4.4 Structural Quality Standards

As repeatedly described for emphasis, documented quality standards are the best means to determine acceptable levels of workmanship, particularly when they are analytically derived.

Owners' and shipbuilders' best interests are served by statistical-control methods which provide constant information about how work processes are performing. Such statistical evidence provides analytical means for an owner to evaluate a shipyard's quality capabilities before contract award. Thus, owners should request such evidence.

In Japan statistical evidence from all shipyards is the basis for establishing analytically-derived accuracy criteria that constitutes description of how the industry normally performs. Thus, personal differences among owner and shipbuilder representatives concerning what constitutes acceptable accuracy, are overcome.

Further, as there is a direct relationship between quality (accuracy) and productivity, statistical-control enables modern shipbuilders to operate a constantly self-improving shipbuilding system with a rate of improvement that can be predicted. Thus, in a very competitive bid, a modern shipbuilder uses current costs discounted by the effect of improvements expected to be obtained during performance of the contemplated construction. Both shipbuilders and owners benefit.

The MarAd Standard Specification includes acceptable levels of plate fairness, but such standards are also required for accuracy alignment of structural members, other structural concerns, welding quality, surface preparation, use of non-destructive testing devices, and removal of lugs, sharp corners, etc. as in the JSQS, QISSP and SPAIS used by IHI shipbuilders. The absence of mutual agreement that such documents facilitate, is the source of much owner/shipbuilder discontent during production.

When hull construction, outfitting and painting are integrated in a modern, zone-oriented shipbuilding system, the procedures and timing for inspecting hull blocks and other inspections, is critical. Thus, both must be carefully considered, organized and made known to surveyors and superintendents representing regulatory bodies and owners respectively. Meetings for pre-contract negotiation are the best time to discuss such matters and to obtain mutual agreement.

3.5 Hull Outfitting
(Sections 5* through 10*)
(Sections 11 and 12)
(Sections 13* through 27*)

3.5.1 General Requirements

MarAd's Standard Specification offers sufficient technical details for designing various hull systems while permitting material specifications, types, etc. to be changed to meet an owner's specific requirements. Ideally, a shipyard should have standards for components such as doors, ladders, hatches, pipe pieces/fittings, hand rails, etc. to be discussed during pre-contract negotiations.

As most conflicts in hull outfitting stem from piping and painting and since they account for a major portion of hull outfitting costs, they should be given special attention during negotiations.

3.5.2 Hull Piping Systems

Most owner/shipbuilder conflicts concerning hull piping (more so for machinery systems where piping is more conjested and complicated) occur at production sites rather that during reviews of specifications and drawings. Design criteria such as working pressures, fluid velocities, viscosities, etc. and material concerns such as pipe schedules, valves, pipe connections, fittings (ells, tees, etc.), insulation, supports, etc., are usually defined enough in the specifications so that many problems can be readily resolved during pre-contract negotiations and/or drawing approvals. However, many conflicts occur when outfitting work is in progress or completed and relate to maintainability, accessibility, bending, welding, flushing, testing, etc. which are apt to be overlooked during pre-contract negotiations.

Problems which relate to operators' needs for access and maintenance can be minimized if, during negotiations, a shipbuilder presents composite drawings of arrangements built in the past to facilitate discussions aimed at clarifying such requirements. Although such composites are not approval drawings they could serve further if used to show an owner's resident inspectors what is intended before starting detail drawings. They could also serve to explain to resident inspectors the shipyard's scheme for test phases following outfitting on-unit and on-block.

The best way for a shipyard to minimize those problems due to welding, flushing, testing, etc., is to have standard procedures available for a customer to review, before contract award.

Proposed diagrammatic of major systems, such as cargo oil, ballast and bilge, should be thoroughly discussed during pre-contract negotiations as they have significant effects on a ship's cost. Major subjects to be discussed include:

o Oil Tankers

Cargo segregation.

Pumping system and type of cargo pumps.

Stripping system.

Cargo loading/unloading time.

Discharge outlet-pressure at shore connection.

Reducers, Y-fittings at discharge stations.

Tank heating coils.

Tank cleaning system.

Clean-ballast system.

Inert-gas systems.

Fire-fighting system.

o Dry-Cargo Vessels

- Ballast system.
- Bilge system.
- Hydraulic system for deck machinery if applicable.
- Fire-fighting system.

3.5.3 Painting

In a most effective shipbuilding firm, to facilitate zone-oriented, integrated hull construction, outfitting and painting, . ..the Basic Design Department prepares a tentative paint scheme and paint budget estimate. These preliminary plans are then negotiated with the owner to better reflect the owner's requirements and practices. The paint scheme and costs are then finalized with the owner. "Basic designers" ...must know not only the theory of painting, but also painting methods at the shipyard. They maintain communications with the (shipyard's) Paint Design Group, the Painting Department and paint manufacturers' representatives in order to remain aware of all the latest data on paint materials and application methods." [3]

Painting related problems almost always occur when work is underway as requirements are difficult to understand from written specifications. Different people have different acceptance criteria in mind. The most controversial areas are:

o Grade of Surface Treatment

Traditional specifications for grades of surface preparation are inadequate because it is hard to visualize generalities such as "commercial", "near white" or "white metal" for every possible combination of type of steel, type of abrasive, etc. The most practical solution is to have owner/shipbuilder agreement that surface preparation will be in accordance with shipyard standard methods and that quality and inspection shall be in accordance with a standard such as IHI's QISSP which features exquisite pictorial aids.

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[3] "Shipyard Design and Planning for a Zone Oriented Painting System", J. Peart and K. Ando, National Shipbuilding Research Program, July 1984, p. 2-1.

o Shop-Primer System

Most shipbuilders apply shop primers immediately after shot blasting in order to protect steel surfaces during parts fabrication and assembly work. Usually, areas damaged by cutting, welding, etc. are power brushed before the next paint coat is applied. However, some owners require complete removal of the shop primer by grit blasting finished subassemblies.

Complete removal should depend on the paint system to be applied and should be a necessary requirement by the paint manufacturer, rather than a preference. Removal of shop primer adds significantly to a ship's price because of the extra process involved and, because of significant adverse impact on a modern shipbuilding system which features zone-oriented, integrated hull construction, outfitting and painting. Therefore a paint manufacturer's true requirements should be confirmed before starting pertinent owner/shipbuilder negotiations.

o Paint Specifications

Although specifications may adequately address type of coating, grade of surface treatment, number of coats, dry-film thickness, etc., there are always differences in application requirements by paint manufacturers who offer the same coating systems. For example, as fewer coats are required, "hi-build" paints are becoming more common in chlorinated-rubber and epoxy paint systems while some paint manufacturers still recommend more coats for the same systems.

Differences will also be found in surface treatment grades for all paint systems and in temperature and humidity limits during application of epoxy coatings. Therefore application requirements should be thoroughly discussed with possible paint suppliers, discussed with owners during pre-contract negotiations and carefully incorporated in the specifications.

Special attention should be given to paint systems, paint brands and/or paint manufacturers that are unfamiliar to the shipyard, owner or both.

In selecting a coating system for cargo tanks, a shipyard must be sure that coating systems are compatible with the products to be carried. Most paint manufacturers have lists which show which products are compatible with their painting systems. However, some such lists are intentionally vague to avoid disclosing that compatibilities are not verified by laboratory tests. Shipyards should identify products to be carried in a ship's trade and should insure that compatibility is guaranteed by the paint supplier.

o Inspection

As for surface preparation, inspection of finished coatings, especially pure epoxy in cargo-oil tanks, often creates conflicts. Dry-film thickness, selection of measuring locations, number of measurements per unit area, type of measurement instruments and treatment of free edges, weld beads and weld splatter are controversial. A shipyard's only protection is to have standard inspection methods and procedures that can be discussed during pre-contract negotiations, e.g., standards for surface preparation of weld areas as illustrated in IHI's QISSP.

o Paint Suppliers

Most owners designate one or two eligible paint suppliers in consideration of suppliers' service networks and other maintenance capabilities. These suppliers should be designated during pre-contract negotiations as paint specifications may differ between suppliers and there may be impact on a ship's cost which could be significant.

3.5.4 Heating, Ventilation and Air Conditioning

There are many air-conditioner manufacturers and usually an owner has a preference based on prior experiences regarding operation and maintenance services. Further, a manufacturer may offer more than one system, e.g., simple central-controlled single duct and double-duct with individual-cabin control. Also heating may be by electricity, hot water or steam with affect on generator and boiler capacities accordingly. Therefore, selection of an air-conditioner manufacturer and development of system specifications should be accomplished during pre-contract negotiations.

There are also alternatives for mechanical ventilation of lavatories, storerooms, etc., i.e., high- or low-pressure systems. The specific type should be determined during negotiations as vent-duct sizes differ significantly and the cabin arrangements and deck clearances will be affected.

Usually two air-conditioning units (each consisting of a compressor, condenser, etc.) are employed to meet specified temperature requirements, i.e., each unit has 50% capacity. Some owners require 100% standby capacity which would double the unit sizes or their numbers. Also, design temperature conditions for an intended trade route may differ from those specified in MarAd standard specification. Therefore, the owner's specific requirements must be known during negotiations before a ship's price is fixed.

Alternatives exist even when individual-cabin units are to be installed. During negotiations, an owner should designate bulkhead-, deck- or ceiling-mounted types as the arrangements of duct and furniture in cabins are significantly affected.

3.6 Machinery (Sections 50 through 86)

3.6.1 General Requirements (Section 50)

U.S. shipbuilders lag shipbuilders elsewhere in acquiring experience with large, slow-speed diesels for propulsion systems. Triggered by the fuel crisis, such propulsion systems have been significantly improved in fuel efficiency through energy saving systems such as: recovery of exhaust-gas heat to generate electric power, propulsion-shaft driven generators, large-diameter slow-speed propellers, etc. As propulsion systems become more complicated, technical negotiations become more difficult for both owners and shipbuilders unless both groups make special efforts to maintain their technical knowledge up to date.

MarAd's Standard Specifications for Diesel Merchant Ship Construction is based upon the use of medium-speed diesels for propulsion and the Machinery Section therein addresses more than just engine-room systems as follows:

o Main propulsion and ancillary systems, i.e., fuel oil, lube oil, cooling, compressed air, remote control, etc.

o Shafting and propeller.

o Electric-power generating and ancillary systems.

o Steam-generating and heating systems.

o Bilge/ballast and miscellaneous ship service systems.

o Fire-fighting system.

o Automation and monitoring systems.

o Workshop machinery systems.

o Hull deck machinery.

Before discussing details during negotiations, basic machinery- and system-design conditions, such as sea-water temperature, ambient-air temperature, fuel oil and other fluid viscosities, cleanliness factors for heat exchangers, list/trim and rolling/pitching conditions, noise levels, etc. should be determined.

Further, general requirements should be determined on the usage of electric and steam generators during navigation, departure/arrival , cargo loading/unloading, and hotel services at anchorages. Also, there should be discussion about the classification of the engine-room automation system and the bases for engine-room design.

A pertinent specification used by a Japanese shipyard is presented in Appendix E.

The Machinery List should be discussed together with the Machinery Arrangement and necessary piping diagrams so that both parties acquire common understanding of the systems.

3.6.2 Main Propulsion Diesel (Section 51)

Diesel-engine types most commonly installed in large ships are either:

o two-cycle slow-speed, or

o four-cycle medium/high speed usually coupled to a reduction gear.

In most cases, selection of an engine type is left to the owner. If selection is left to the shipyard, then the shipyard should provide rationale for determining the engine type selected.

Systems associated with an engine are, more or less, automatically determined by the engine type selected as engine manufacturers provide their standard diagrammatic and ancillary-machinery capacities.

Particularly when an engine is to be built by a licensee, most owners are concerned with interchangeability of components and spare parts in order to facilitate post-delivery maintenance. Therefore, interchangeability needs should be discussed during negotiations and incorporated in the specifications.

Most slow-speed diesels are now provided with different ratings, i.e., for:

o high horsepower with high fuel-consumption, and

o low horsepower with low fuel consumption.

Therefore, during negotiations, a shipbuilder must determine for sure the rating desired by an owner as the shafting and propeller design is dependent on the rating selected.

Ancillary systems should be thoroughly discussed during negotiations, using their diagrammatic as references.

The type and quality of fuel oil usable for a main diesel engine is of great concern for both a shipbuilder and owner because of significant impact on cost of ship operation. Most slow-speed diesels are designed to burn low-quality heavy fuel oil of up to 6,000 seconds Redwood No. 1 at 38 degrees C (or 100 degrees F). Most medium-speed diesels require higher quality fuel such as a diesel blend.

Fuel quality also affects design of a fuel-oil piping system as low-grade high-viscosity fuel requires additional heating capacity and piping insulation and better purifying capabilities. Therefore, the type and quality of fuel required must be discussed with the owner and written into the specifications.

The main diesel engine fuel-consumption rate is usually a guarantee item in a shipbuilding contract. The rate, i.e., grams (or pounds) per hour per horsepower, should be guaranteed based upon shop tests by the engine manufacturer during which brake horsepower and fuel consumption can be accurately determined. Measurements during sea trials are not satisfactory because they contain subtle errors caused by irregular sea conditions, portable measuring devices, etc., which are difficult to identify and assess.

3.6.3 Shafting and Propeller (Section 53)

Propeller shafting is usually designed to be in excess of classification rule requirements by incorporating a margin in shafting diameter. The amount of margin should be in accordance with an owner's requirement. In the case of slow-speed diesels having five or less cylinders, shafting-diameter determinations must also include very careful assessment of the torsional vibration characteristics of the engine. In many cases, shaft diameters are increased considerably in order to shift natural frequencies, i.e, resonant ranges away from excitation frequencies associated with engine RPM ranges.

The shaft-alignment method to be used is usually not in a traditional shipbuilding specification. The method should be described in a written shipyard standard and generally explained during pre-contract negotiations to prevent misunderstandings and conflicts when alignment work is underway. A shaft alignment-standard could be incorporated in a shipyard's publication for production and inspection standards that is referenced in contracts.

Design of a propeller is a matter of special importance for diesel propulsion because of increased torque due to underwater-hull fouling and due to the effect of engine aging.

For diesel propelled ships, the propeller is designed "lighter" in order to prevent over torque of the engine when a ship's underwater hull becomes foul. In other words, the propeller is designed to absorb the engine's normal rated horsepower at a propeller revolution of about 4-5% higher than the specified RPM of the engine at normal rated horsepower. For example, if an engine is designed to deliver normal rated horsepower at 100 RPM, the propeller should be designed to absorb normal rated horsepower at 104-105 RPM. The propeller design RPM is usually recommended by the engine manufacturer.

Selection of the number of propeller blades is also very important because the natural frequency of a hull or hull component could be excited unacceptably by propeller-blade frequency (number of blades x RPM). Preliminary vibration calculations should be made to assess natural frequency of a hull before determining the number of propeller blades required.

As the dynamics of an entire propulsion system consisting of an engine, shafting and propeller are complicated and are influenced by hull form and condition, pertinent responsibilities should be given special attention. To insure such attention during pre-contract negotiations there should be a high-priority check-list item noting need to obtain before contract award, clear agreement concerning responsibilities for decisions that could impact on specified performance of the propulsion system.

3.6.4 Machinery Piping Systems (Sections 56 through 63)

Piping systems in main machinery spaces can be classified as:

- o main- and auxiliary- diesel systems,
- o steam generating system, or
- o ship's service systems.

Most systems for main and auxiliary diesels are designed to meet an engine manufacturer's specifications and standard diagrammatic. Although basic patterns are standardized, there is some design flexibility in combining them with other systems.

As for hull piping, most conflicts center on workmanship during pipe fabrication and assembly processes and on accessibility and maintainability for ship operation, rather than on how a system functions. Functional aspects are usually adequately discussed and clearly defined during pre-contract negotiations with the aid of proposed piping diagrams, machinery arrangements and specifications.

Thus, each shipyard should have a booklet which describes piping practices normally applied such as for welding and bending, statistically derived tolerance limits, galvanizing, coating, alignment, flushing and testing. As such practices are usually not referenced in specifications, the booklet would serve for discussion during negotiations and as a reference invoked by a shipbuilding contract.

Accessibility and maintainability can sometimes be adequately verified before construction on composite drawings. When arrangements are very complicated, three-dimensional scale models, ideally employed for the act of designing as well as for checking and conferring with owner's representatives, provide the best means to avoid such conflicts during construction. [4]

3.6.5 Steam Generating Plant (Section 61)

The steam generating plant in a diesel propelled ship normally consists of means for recovering heat from the main-engine exhaust as needed for generating heating and hotel-services steam when a ship is underway. The plant also includes an oil-fired auxiliary boiler to supply such steam when the ship is in port.

For dry-cargo ships, in which steam demand is low and almost equal when at sea and in port, use of a package-type unit combining an exhaust-gas heater and oil-fired boiler, is an alternative that saves space and reduces cost.

Main diesels of large horsepower ratings have enough exhaust-gas heat to generate steam for turbo-generators to provide electric power when a ship is underway. Also, developments in energy-saving systems now enable feedback of resultant power to the main propulsion system. Therefore, trade-off studies of various alternatives that best suit a ship's service demands, are recommended in time for them to be discussed with the owner during pre-contract negotiations.

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[4] See the National Shipbuilding Research Program (NSRP) publication "Design Modeling - July 1984".

3.6.6 Auxiliary Diesels for Electric Generators (Section 76)

The number of electric generators required is determined in accordance with regulatory-body rules and regulations. The usage requirements for generators during navigation, departure/arrival, loading/unloading and at anchor, should be clearly defined based on an electric-load analysis.

In diesel propelled ships, medium or high-speed diesels are normally used to drive electric generators. However, some owners prefer slower-speed engines (approximately 500-900 RPM) because less problems are encountered with heavy fuel oils. Selection of RPM is quite important as it has considerable affect on engine cost.

A relatively recent development is a power-take-off (PTO) generator connected so as to be driven by the main propulsion system at sea and by an auxiliary diesel in port. In port, sufficient power is provided for cargo handling machinery (winches, cargo pumps, etc.). At sea, the auxiliary engine serves as a back-up or take-home engine should the main diesel become inoperative.

As such new systems are of great benefit to owners, appropriate trade-off studies should be made in time for discussion during pre-contract negotiations.

3.6.7 Hull Machinery (Section 81)

o General

Hull machinery includes any of the following located outside of an engine room:

Steering engine.

Anchor windlass.

Mooring, cargo, boat and ladder winches.

Store and cargo deck-cranes.

Refrigeration units or components.

The type of power to be used for cargo and mooring machinery is chosen considering the most efficient use of power. For example, steam deck machinery is most suitable for tankers which have large boilers to supply cargo-pump steam. Electric or electro-hydraulic deck machinery is more suitable for dry-cargo vessels or for tankers which employ deep-well pumps or submerged pumps.

Electric-driven deck machinery is more convenient for independent control, but is more costly for tankers as explosion-proof motors are required. Electro-hydraulic deck machinery has the advantage of using a centralized hydraulic-power source which could serve both cargo-handling and mooring systems.

When electro-hydraulic deck machinery is used, there are alternatives such as:

a central pump serving several machines in series,

- 3-way valves to switch hydraulic power from one machine to another, or

a self-contained hydraulic unit in each machine.

When a central pump is to be used, care must be exercised in grouping the machines that are going to be powered by the same hydraulic circuit so that operation of one machine will not interfere with the others. Using proposed diagrammatic as references, the operation mode of such systems must necessarily be discussed and confirmed during pre-contract negotiations.

o Steering Gear

Basically, there are two types of steering gear to select from, namely, the two- or four-cylinder Rapson-slide type and the rotary-vane type. The choice should be discussed with the owner during pre-contract negotiations.

Although very rare, a steering angle of over 35 degrees may be required for ships which are to operate in narrow channels. Such requirement affects design and torque requirements.

o Windlasses, Mooring Winches and Capstans

There are many types of windlasses to select from depending upon size and form of a ship's bow. A small or slender ship can be equipped with a single windlass which is fitted with a wildcat on each side. A large ship with a full bow requires two windlasses, each with one wildcat. The windlasses are located some distance apart to handle the port and starboard anchors accordingly.

A windlass can also be combined with a mooring winch by connecting one or two hawser drums via clutches on the wildcat shaft. Such machinery types and combinations have to be discussed during pre-contract negotiations because consideration must be given to the piers that an owner plans to use.

The owner's port captain should participate in pre-contract discussions of the type and arrangement of mooring winches. Depending upon a deck arrangement, a mooring winch could be fitted with one or more hawser drums, via clutches, to a single drive shaft so that they can be operated independently.

o Cargo Winches and Cargo Deck Cranes

The power sources for cargo winches and cargo deck cranes could be either electric or electro-hydraulic, depending on an owner's choice. Most electric winches and cranes are driven by alternating-current (AC) motors. Hoisting speed will change in steps if pole-change type motors are used. In order to simulate continuous-speed changes that characterize direct-current (DC) motors, some owners require special-type control which is relatively expensive.

Electro-hydraulic winches and cranes can be typed as having low-, medium- or high-pressure power units. Rotary-vane oil motors are normally used with the first two types to accommodate speed changes that are made continuously. Selection of oil pressure is left to the owner. However, all options for winches and cranes impact on costs. Therefore, decisions should be made as a consequence of discussions during pre-contract negotiations.

3.7 Electrical (Sections 87 through 98)

3.7.1 General Requirements (Section 87)

As in the Hull and Machinery parts, electrical basic design conditions, applicable rules, regulations, standards, etc., should be discussed before entering into specific details.

Basic design conditions should include:

- o Voltage, frequency, phases, conductors for distribution to various systems.
- o Grounding.
- o Type and size of sockets and terminals.
- o Type of fuses.

The number of generators and usage conditions, including a shaft-driven generator if to be installed, should be clearly defined in conjunction with the electric-load analysis.

The electric specifications should cover all electrical systems throughout a ship and can be categorized as:

- o Electric-power generating systems.
- o Power distribution systems including cables.
- o Motors and controls.
- o Electric-lighting systems.
- o Radio and telegraph systems.
- o Navigations systems.
- o Interior communication systems.
- o Automation and monitoring systems.

The rapid progress in electronics and computer technologies requires incessant review to keep up with the state of the art. Thus, special attention regarding such new technologies should be paid by both an owner and a shipbuilder during pre-contract negotiations.

3.7.2 Generators (Section 88)

- o Ship Service Generator

Ship service generators for diesel ships are normally diesel driven. However, recent trends for energy savings and less maintenance are to employ main engine shaft-driven generators or turbines which are supplied with steam generated by a main engine exhaust-gas heat recovery system.

Although the main purpose of a shaft-driven generator is to supply required electric power when a ship is underway, it could be sized to satisfy cargo-handling demand by connecting a back-up diesel and/or making provision for using one main engine as the prime mover in the case of twin-engine propulsion. Therefore, generator capacity, its combination with the main propulsion system, a power take-off method, etc., should be discussed with the owner during pre-contract negotiations.

Systems for taking off power from a main engine vary depending upon the engine type and make. Necessarily, technical details should be discussed with potential engine and generator manufacturers as preparation for pre-contract negotiations with an owner.

When considering a shaft-driven generator, a controllable-pitch propeller (CPP) vs. a fixed-pitch propeller (FPP) will become an issue.

The combination of a shaft-driven generator and a CPP is ideal as the engine can be operated at constant speed for constant electric-power frequency regardless of engine speed or direction (ahead or astern). Such combination with a FPP means that necessary variation in engine RPM, particularly when maneuvering, will require switching over to a diesel generator.

Thus, selection of a propeller type could be quite important for electric-power generation. Advantages and disadvantages including cost analyses should be discussed with an owner during pre-contract negotiations. The major items which should be discussed are:

Electric-Load Analysis including calculation method to determine generator capacity, i.e., load factors, motor efficiencies, continuous/intermittent loads in various conditions, usage factors, etc.

Structure and characteristics of diesel generators.

Structure and characteristics of shaft-driven generators including frequency control, change-over condition for shift to diesel generator, etc.

Excitation and voltage regulators, etc.

3.7.3 Power Distribution System (Sections 89 and 90)

The power distribution system should be discussed with an owner based upon Electric One-Line Diagrams. The major items to be discussed are:

- Power supply system to major machinery and equipment.
- Changeover method from the main power supply line to the emergency power line including the load analysis for the emergency generator.
- Structure and enclosure of the main switchboard, distribution and group starter panels, type and arrangement of switchboard instruments, indicating lamps, etc.
- Generator control method.
- Types of cables for primary and secondary sources.
- Cable calculations.
- Cable installation methods.
- Type and capacity of transformers including required capacity calculations.
- Type of batteries including required capacity calculations,
- Standard equipment and fittings, i.e., circuit breakers, relays, contractors, fuses, cable trays, penetration fittings, etc.

3.7.4 Motors and Controllers (Section 91)

Generally, most owners require all motors to be supplied by the same manufacturer, including small motors which are usually built in certain equipment. The major items to be discussed are:

- Motor type, construction, rating, characteristics, insulation grade, etc., including environmental requirements, i.e., heaters, drip/water/explosion proof, etc.
- Starter types and starting and voltage-protection methods.
- Grouping for group starter panels.

3.7.5 Other Electrical Systems

Regarding other electrical systems the following should be discussed:

- Lighting Systems
  - Illumination levels.
  - Type of illumination, i.e., fluorescent or incandescent including light fixture locations.
  - Locations of emergency lights.

- Type and arrangement of cargo lights, projector lights, navigation and signal lights, etc., including their controls.

- Standard equipment and fittings, i.e., receptacles, ceiling and berth lights, exterior lights, etc.

o Radio and Telegraph Systems

- Radio room arrangement.

- Antenna arrangement.

- Radio equipment and VHF radio telephone.

- Entertainment system, i.e., stereo console, TV, video tape recorder/ player, individual radio receiving outlets, etc.

o Navigation Systems

- Number, type and locations of electric and electronic navigation equipment, e.g., gyro compass, autopilot, echo sounder, underwater log, radar, loran, radio direction finder, NNSS, collision avoidance system, rudder-angle indicator, and electric tachometer.

- Type and locations of engine telegraphs including transmitters, indicators, loggers, etc.

- Electric clocks, including master and slave locations.

- Bridge console stand.

o Interior Communication Systems

- Type and locations of telephone equipment.

- Public address system.

- Call signals and alarms.

3.8 Automation, Centralized Control and Monitoring Systems

The application of automation, centralized control and monitoring (ACCM) of machinery systems is a common practice in modern ships for a number of reasons which include: reducing the size of an operating crew, eliminating tiresome watchkeeping, which regarding data collection is boring and human-error prone, and providing an ideal environment for operating personnel, i.e., an air-conditioned, noise-quieted control space.

Most new oceangoing ships are authorized to have unattended engine rooms in accordance with regulations and classification rules as administered by the U.S. Coast Guard and American Bureau of Shipping respectively.

As an ACCM system affects requirements for hull, machinery and electrical systems, incorporating ACCM specifications in one section is advisable as compared to distributing ACCM requirements in the various specification sections for hull, machinery and electrical systems. This approach minimizes inconsistencies between the various section requirements and opportunities to overlook something.

An ACCM system can be categorized as follows:

o Main engine remote control system.

o Automatic control of machinery and piping systems.

o Monitoring systems for main engine and auxiliaries.

o Engine-room fire protection.

Before entering into details ACCM general requirements should be discussed with an owner, such as:

- Basic functions of bridge control and engine room centralized control of main engine.
- Applicable rules and regulations.
- Automatic and remote operation of vital auxiliaries, valves, etc.
- Machinery, particularly pumps, requiring automatic start-up capabilities upon failure of another machine.
- Features for bridge and engine-room consoles.
- Design conditions, such as, environment temperature, humidity, vibration, etc.
- Types of pressure gages, thermometers, level indicators, flow meters, etc.

3.8.1 Main Engine Remote Control System

Most engine manufacturers offer remote controls that they regard as standard for a particular engine. Thus, including the engine manufacturer's basic requirements in the system design is prudent. Modern remote-control systems employ either pneumatic or electronic devices and owners may have a preference. Therefore the alternatives should be discussed before contract award.

The functions of bridge and engine-room control consoles are to start, stop, reverse, accelerate or decelerate a main engine in accordance with prescribed sequences and program controls. However, the bridge console is sometimes combined with navigation equipment such as engine telegraph, radar, rudder-angle indicator, tachometer and echo-sounding recorder.

Also, communication features are sometimes added such as for telephone and public announcement. Of course, if a CCP is specified, its control should be in the bridge console. As owner respond differently to the many alternatives, how such functions are to be combined and even the location of a console in the wheelhouse should be carefully discussed during pre-contract negotiations.

Similar discussion should also address the engine-room control console which also usually incorporates additional features, e.g., remote-control switches, indicators lamps and gages for vital machinery, monitoring and logging devices, telephones, engine telegraph, and CPP control if a CPP is specified.

Above all, pre-contract discussion should clearly identify what a control system is supposed to accomplish. At least the following questions should be answered:

- What performance is required, particularly during maneuvering?
- What are the requirements for system analysis, particularly if a CPP is specified?
- What is the primary purpose of the control system? Is it to be reliably responsive? Is it to respond quickly, as for a ferry, or is it to be designed for fuel economy or both?

3.8.2 Centralized Control and Monitoring System

Ships' main propulsion plants and auxiliaries must comply with requirements imposed by regulators and classification societies. Also, a recent trend is to obtain certification for unattended engine-room operation.

Automatic control, remote control and monitoring systems are usually integrated into a centralized control station located in the engine room. The location as well as automatic and manual protection and safety devices, the related instrumentation required, such as devices for display, annunciation, alarm, activation and control of machinery and equipment, should be discussed with the owner so that a general concept, developed before contract award, can be used as a basis for detail design development after contract award.

In order to facilitate such discussions, required functions should be tabulated so that the instruments for each machine or system can be readily identified and checked for omissions. The tabulation should be meticulously prepared as requirements for attaching a sensor to a machine after the shipbuilder's purchase order is released could become inordinately expensive in both money and time. Samples of such tables are shown in Appendix F.

3.9 Tests and Trials (Section 101)

The conduct of tests and trials is a significant source of conflict that is directly attributable to inadequate presentation of requirements by both parties and appropriate discussions before contract award. However, most are due to a shipbuilder not providing enough information.

Protocol for tests and trials should be standardized and documented so that procedures and acceptance levels can be readily understood by an owner. Some test procedures already published could be adopted, e.g., the code for sea trials and vibration analysis published by The Society of Naval Architects and Marine Engineers.

When zone orientation is applied a significant amount of testing is performed just after completion of block assembly, outfitting on-unit and outfitting on-block. Shop techniques employing vacuum boxes or pressurized fillet welds are routinely applied by some shipbuilders to test watertight and oil tight joints in blocks before hull erection. Also, special shop tests may be necessary for pipe pieces for critical systems. Outfit units are sometimes hydrostatic tested in shops and sometimes after they are fitted on block. Complete systems are tested on board. The test plan, schedules, procedures and acceptance levels should be discussed before contract award to avoid problems at test sites.

Test methods for guarantee items such as for deadweight, trial speed and main engine fuel consumption should be particularly defined so that measurements and analyses are based on the same criteria.

3.9.1 Machinery and Equipment Shop Tests

Tests of machinery and equipment in a manufacturer's shop requiring attendance by owner, shipyard, regulatory and/or classification representatives, must be especially clarified. Durations of various load tests and extents of open and inspect efforts after tests are some of the specifics that should be addressed during pre-contract negotiations.

3.9.2 Sea Trials

As it is impractical to fully load dry-cargo vessels before delivery, the draft conditions for sea trials should be determined during basic design before contract award, considering ballast tank availability, fuel oil, fresh water, stores and consumables which could be loaded. Trial speed should be guaranteed at a displacement so determined.

Generally, trial speed is guaranteed at maxim continuous rated horsepower (MCR). However, for diesel propelled dry-cargo ships, propeller RPM at trial condition will be higher than the nominal engine RPM due to the ship's lighter draft condition, clean hull and 4 to 5% RPM increase for a margin as described in Part 3.6.3.

The engine MCR may not be available during sea trials if the RPM corresponding to MCR exceeds a limiting RPM imposed by allowable piston speed. Thus, there should be owner/shipbuilder agreement before contract award that trial speed will be guaranteed at normal rated horsepower (NOR).

Also, pre-contract discussions should address disposition of fuel oil, lube oil, hydraulic fluids, etc., that remain in tanks and pipes after sea trials are completed. Usually, per pre-contract agreement, unused quantities are purchased by the owner at rates specified on suppliers' invoices to the shipyard.

4.0 PRACTICAL SUGGESTIONS

4.1 Check List

Completing pre-contract negotiations within a limited time frame and yet clarifying all major design, material and production items, are tough tasks for any shipyard. For a relatively simple bulk carrier or container ship, particularly when there is prior experience with the owner, sophisticated shipbuilders sometimes complete negotiation of technical matters within two weeks. However, if there is no prior experience with a specific owner and vessel type the same negotiations may take as much as four weeks.

For very complex ships, such as some modern product carriers and depending on pertinent prior experiences, one to two months for pre-contract negotiations is reasonable. The longer time span is required due to the great number of subjects that have to be discussed.

Use of a shipyard standard check list for each category, i.e., hull, machinery and electrical, is virtually essential. Such lists, incorporating priorities, greatly unburden shipbuilder/owner participants from having to consider what subjects require negotiations and from fear of overlooking something important. Obviously, check lists best serve shipbuilder/owner representatives who have no prior experience in negotiating technical matters.

Check list items should be compiled to correspond with contents of proposed specifications and plans. Further, priority designations should be honored to insure that at least those having the highest priorities will be negotiated if a time frame allowed for pre-contract negotiations is limited.

4.2 Standards and Practices

In order to be as effective as the world's leading shipbuilders, documented standards and practices are essential tools for pre-contract negotiations. When necessary, they are attached to a contract as evidence of agreements.

Such standard production practices for quality and accuracy, inspection and testing, piping, painting, etc. are the most effective means for supplementing specifications. The QISSP and SPAIS are excellent examples specifically prepared and used by IHI for such purpose.

4.3 Specifications and Contract Plans

The MarAd standard specifications for ship construction, including the diesel version, have long been and continue to be used as basic format and criteria by U.S. owners, design firms, and shipbuilders despite the fact that the Merchant Marine Act of 1970 allows negotiated specifications between owners and shipbuilders. Cut-and-paste usage of the MarAd specifications persists even though special requirements for discontinued Construction Differential Subsidy (CDS) are included. A few independent design firms significantly departed from the MarAd standard specifications, particularly for specialty ships, but have since gotten into a cut-and-paste mode without taking sufficient time for incorporating the influences of modern, constantly self-improving shipbuilding systems.

Some believe that government support, such as CDS, in the absence of competition does little if anything for development of shipbuilding technology. As an alternative, a Japanese shipbuilding authority proposed that government funds in amounts commensurate with a government's interests, should be used to encourage particular trades. [1]

Then, those who wish to compete for available subsidy would have to form into owner/shipbuilder teams. An essential part of each team's bid preparation would be negotiation of technical items as discussed in this publication in order to be able to propose the best performing ship(s) for a particular trade which can be built with the highest order of productivity.

Instead, the MarAd standard specifications unify quality and grades of materials, machinery and equipment so that bid prices quoted by several shipyards would be based upon the same quality and criteria. There is no incentive to negotiate technical matters as described herein for developing a specification that benefits both parties and spurs advancement of both ship operating and shipbuilding technologies. In order to continuously permit such improvements, a shipbuilding specification must be viable and negotiable.

As the MarAd standard specifications are no longer mandatory, shipbuilding specifications should be simplified and made more resilient to allow shipyards to select materials which are less expensive but still meet specification requirements.

Also, traditional U.S. contract plans and specifications are design oriented and disregard production requirements. They are a significant source of owner/shipbuilder conflicts during production activities when implementation without hassles is prerequisite for efficiency.

Contract specifications and plans must incorporate production requirements. In other words they must be product oriented so that the ship's price will be commensurate with a shipyard's normal shipbuilding practices and workmanship. "product oriented" means more than the traditional adage "design for production".

To modern shipbuilders, "product oriented" means having a cadre of production engineers who can devise and document a build strategy, first in terms of pre-definition, in time to employ the strategy for basic design. Further, as each design phase progresses and makes available more information, "product oriented" means refining the build strategy in time to guide the next phase of design development. [2]

A build strategy, unique for each shipyard, at first pre-defines erection butts and seams in order to achieve hull blocks that will permit a shipbuilder to exploit Group Technology and manufacture hull parts, sub-blocks and blocks on dedicated process lanes.

[1] Dr. H. Shinto, former President, IHI, when interviewed by L.D. Chirillo, in October 1980 at the University of Michigan.

[2] See the National Shipbuilding Research Program (NSRP) publication "Integrated Hull Construction, Outfitting and Painting - May 1983."

Such pre-definition also addresses development of a machinery arrangement that honors an owner's need for accessibility and maintainability while simultaneously maximizing assembly of fittings on-unit and on-block and minimizing fitting on-board. The arrangement also insures uniform distribution of pipe pieces, port and starboard and through the various engine-room levels, as much as possible in parallel banks of straight pipe lengths.

The strategy expressed in terms of zones by stages, enables designers to shift to zone-oriented drawings immediately after functional design so that design end-products are composites which literally constitute work instructions. Even details such as where to tap a filet weld for an air-pressure test, are included in structural detail drawings.

Because a documented build strategy, standards, etc. create assurances for both an owner and shipbuilder, the scope of proposed contract and guidance plans can be reduced to a minimum in order to save time and money for such engineering to guide technical negotiations before contract award. Reference drawings from similar ships, standard diagrams and even freehand sketches, are also useful for effective pre-contract negotiations.

APPENDIX A

QUESTIONNAIRES AND ANSWER SUMMARIES

The following objective was stated on the cover sheet of the questionnaires described herein:

"Contract Negotiation for Technical Matters is one of the tasks of the National Shipbuilding Research Program sponsored by the U.S. Maritime Administration, contracted to Todd Pacific Shipyards Corporation.

The purpose of this task is to develop a manual which provides guidance to the U.S. shipbuilding industry to identify and clarify technical matters during contract negotiations to prevent any misunderstandings and/or conflicts between the buyer and the builder during ship construction.

This questionnaire has been prepared to identify the nature and frequency of the conflicts or trouble experienced in the past so that the manual could provide practical suggestions to resolve these problems.

The information obtained by this questionnaire will be confidential, and will only be used for statistical analysis of the problems occurred.

The word 'trouble' used in the questionnaires is defined as occurrence of an undesirable conflict between the buyer and builder which effects a ship's production schedule, production costs, delivery time, etc."

Some questions for owners are necessarily different from those for shipbuilders but are in the same context. Thus, they are organized on opposite pages to facilitate comparison.

Responses to requests for priority order or orders of occurrence, e.g., questions C.l. and C.2., were assigned weighted values as follows:

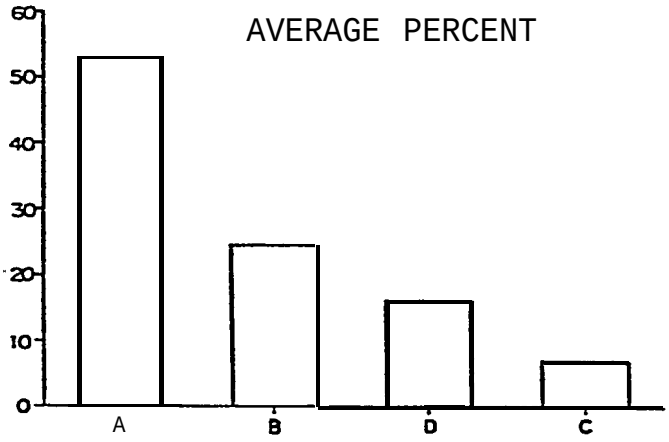
Rank	Priority Example		Weight Value
Top Priority	1	1	3
Medium Priority	2-3	2-4	2
Low Prioritty	4-5	5-10	1
No Answer			0
(Nos. of Answers)	(5)	(l0)	

Please reply to the following questions based upon your actual experience in building commercial vessels.

A. General:

1. Who will furnish the technical documents, such as Specifications, General Arrangement Plan, Machinery Arrangement Plan, Midship Section, etc. for contract negotiation? (in respective percentage)

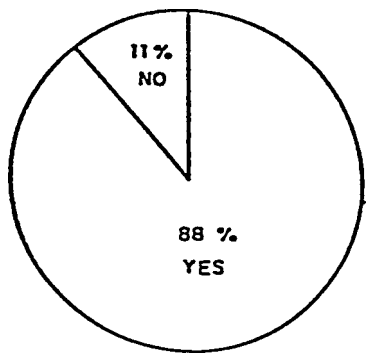
a. Shipyard	____ %
b. Owner (with Engineering Department)	____ %
c. Independent Consulting or Engineering firm	____ %
d. Others (specify)	____ %
Total	100 %



A: SNIPYARD
B: OWNER
C: INDEPENDENT CONSULTING OR ENGINEERING FIRM
D: OTHERS

2. Have you ever experienced any troubles or inconvenience during construction of ships due to incomplete contract negotiation or technical matters?

_____ Yes
_____ No



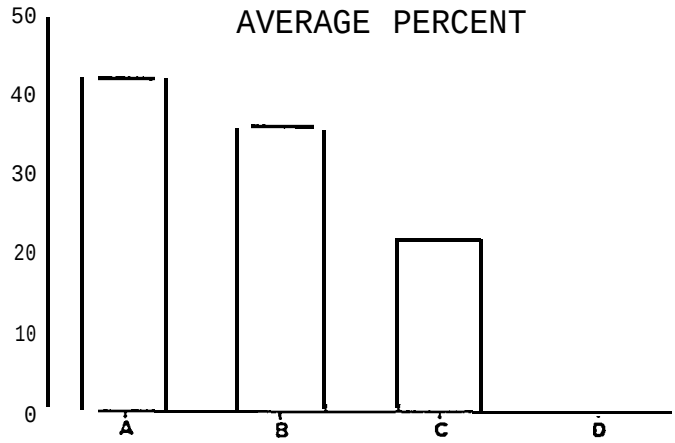
FOR SHIP OWNERS

Please reply to the following questions based upon your actual experience in building commercial vessels.

A. General:

1. Who will furnish the technical documents, such as Specifications, General Arrangement Plan, Machinery Arrangement Plan, Midship Section, etc. for contract negotiation? (in respective percentage)

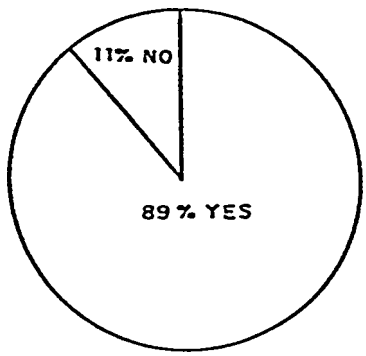
a. Shipyard	____ %
b. Owner (with Engineering Department)	____ %
c. Independent Consulting or Engineering firm	____ %
d. Others (specify)	____ %
Total	100 %



A: SHIPYARD
B: OWNER
C: INDEPENDENT CONSULTING OR ENGINEERING FIRM
D: OTHERS

2. Have you ever experieced any troubles or inconvenience during construction of ships due to incomplete contract negotiation or technical matters?

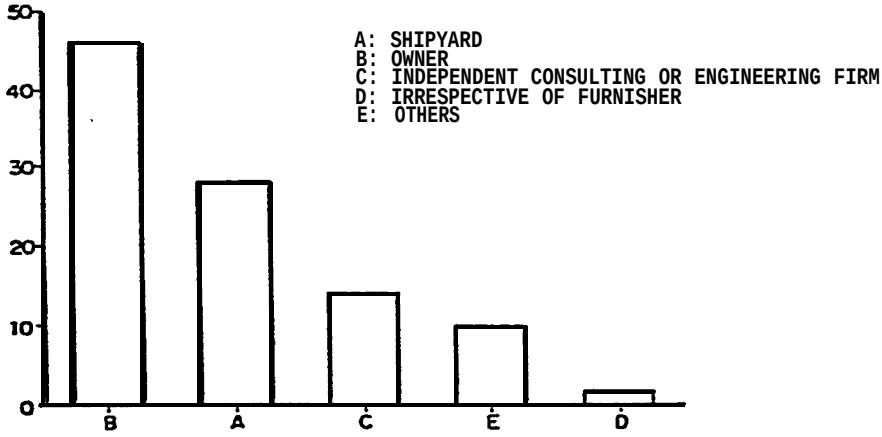
____ Yes
____ No



If yes, who furnished the technical documents mentioned above? (in respective percentage)

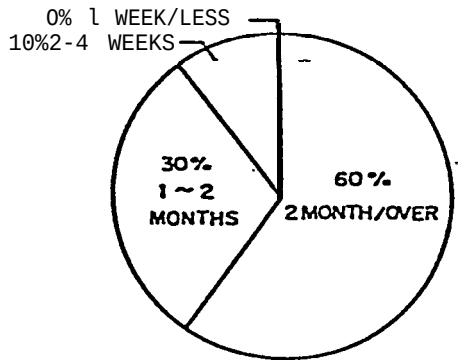
a. Shipyard	____%
b. Owner	____%
c. Independent Consulting or Engineering firm	____%
d. Irrespective of furnisher	____%
e. Others (specify)	____%
Total	100 %

AVERAGE PERCENT



3. How long do you spend for contract negotiations to clarify technical matters? (in average)

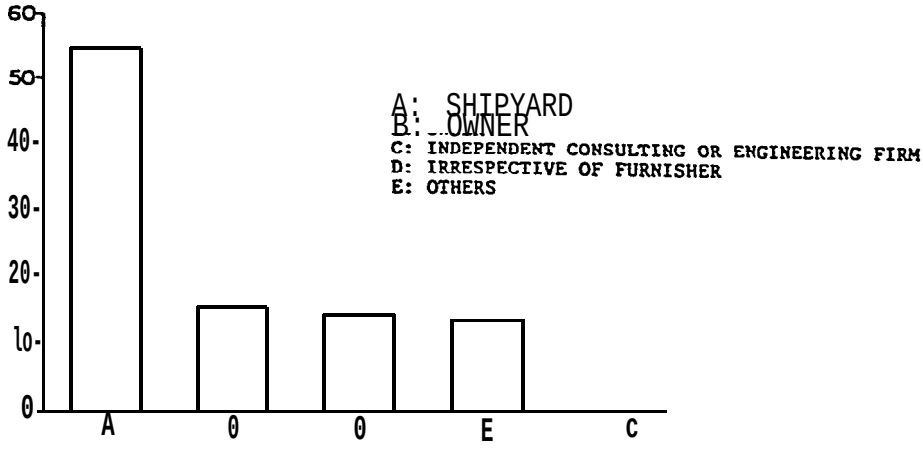
_____ One week or less
_____ 2-4 weeks
_____ 1-2 months
_____ Two months or over



If yes, who furnished the technical documents mentioned above? (in respective percentage)

a.	Shipyard	____ %
b.	Owner	____ %
c.	Independent Consulting or Engineering firm	____ %
d.	Irrespective of furnisher	____ %
e.	Others (specify)	____ %
	Total	100 %

AVERAGE PERCENT



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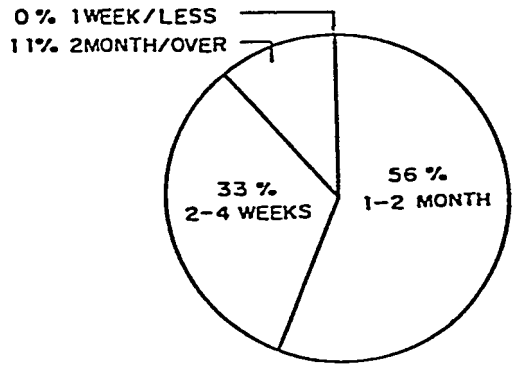
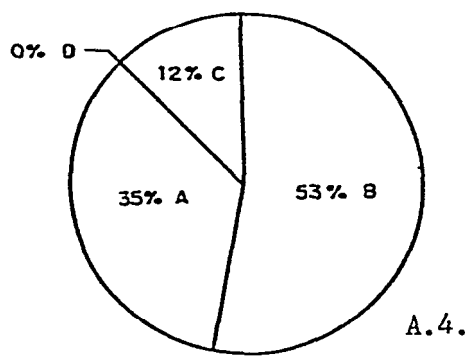


4. Where is the contract negotiation on technical matters held normally?

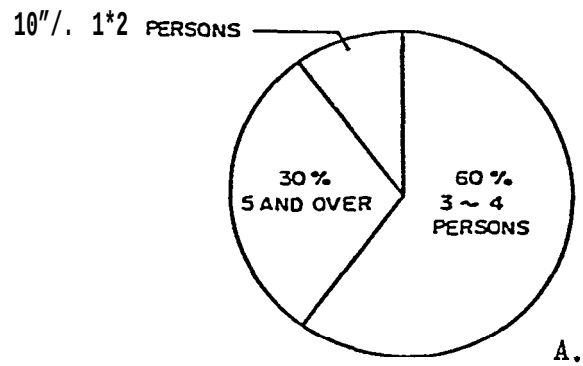
_____ At Owner's Office
_____ At Shipyard's Office
_____ At Independent Consulting or Engineering Firm's Office
_____ Others (specify)_____

5. How manv technical Dersonnels representing your shipyard are involved in the technical negotiations for the contract?

_____ 1 - 2 persons
_____ 3 - 4 persons
_____ 5 and over



A.4.



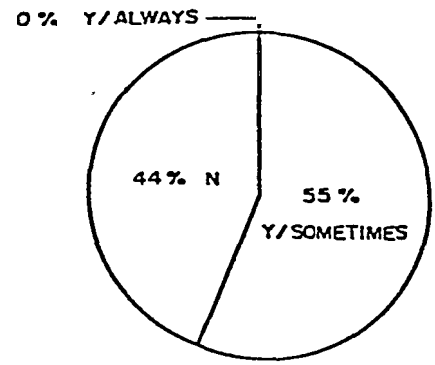
A.5.

A: AT OWNER'S OFFICE
B: AT SHIPYARD'S OFFICE
C: AT INDEPENDENT CONSULTING OR ENGINEERING FIRM'S OFFICE
D: OTHERS

B. MARAD's Standard Specification:

1. Do you use MARAD's standard specifications as the basis for your contract specifications?

_____ Yes, always
_____ Yes, sometimes
_____ No

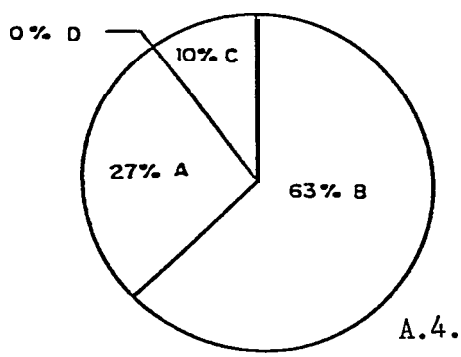


4. Where is the contract negotiation on technical matters held normally?

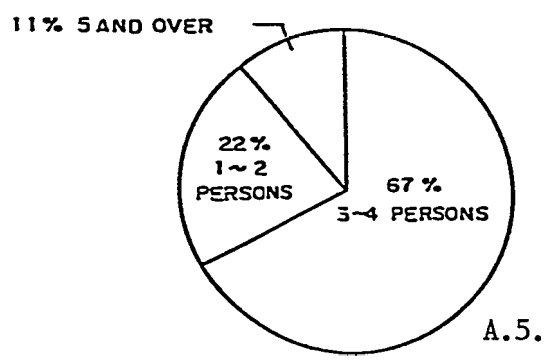
_____ At Owner's Office
_____ At Shipyard's Office
_____ At Independent Consulting or Engineering Firm's Office
_____ Others (specify)_____

5. How many technical personnel representing your party are involved in the technical negotiations for the contract?

_____ 1 - 2 persons
_____ 3 - 4 persons
_____ 5 and over



A.4.



A.5.

A: AT OWNER'S OFFICE
B: AT SHIPYARD 'S OFFICE
C: AT INDEPENDENT CONSULTING OR ENGINEERING FIRM'S S OFFICE
D: OTHERS

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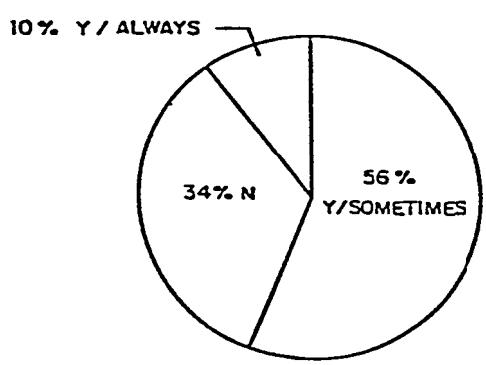
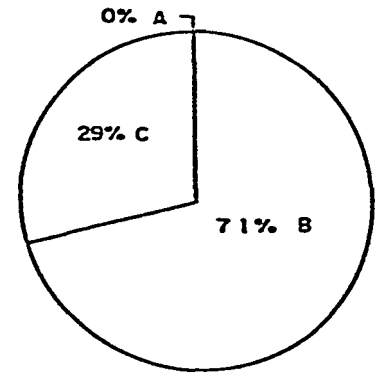


2. If CDS is not applied, how will you utilize MARAD's specifications?

_____ Will continue to use it.
_____ Will use it depending on the case.
_____ Will stop using it.

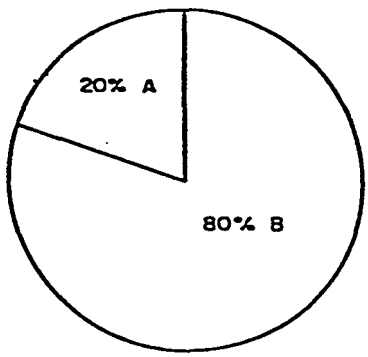


A: WILL CONTINUE TO USE IT
B: WILL USE IT DEPENDING ON THE CASE
C: WILL STOP USING IT

If you have selected either the first or second answer of above, your answer to-following questions 3 and 4 is requested.

3. What is your comment on MARAD's specifications?

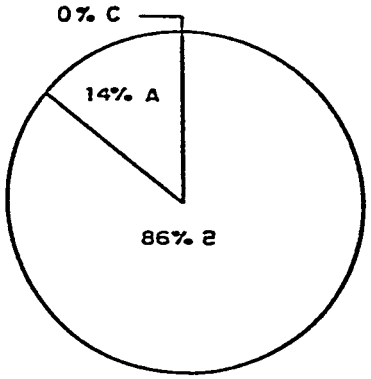
_____ No revision is required.
_____ Revision is required.



A: NO REVISION IS REQUIRED
B: REVISION IS REQUIRED

2. If CDS is not applied, how will you utilize MARAD's specifications?

_____ Will continue to use it.
_____ Will use it depending on the case.
_____ Will stop using it.



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C: WILL STOP USING IT

If you have selected either the first or second answer of above, your answer to following questions 3 and 4 is requested.

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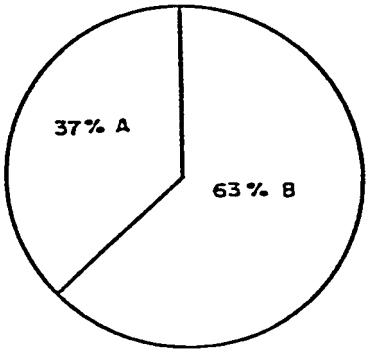


A: NO REVISION IS REQUIRED
B: REVISION IS REQUIRED

4. If revision is required, in what priority order should it be revised among the following items? (number priority order)

   a. Description should be more simplified _____
      Chapters to be simplified _____

   b. Description should be more detailed _____
      Chapters to be detailed _____

   c. Kinds of technical documents accompanying the Contract should be reduced _____
      Documents to be exempted (specify below)

      _____
      _____
      _____

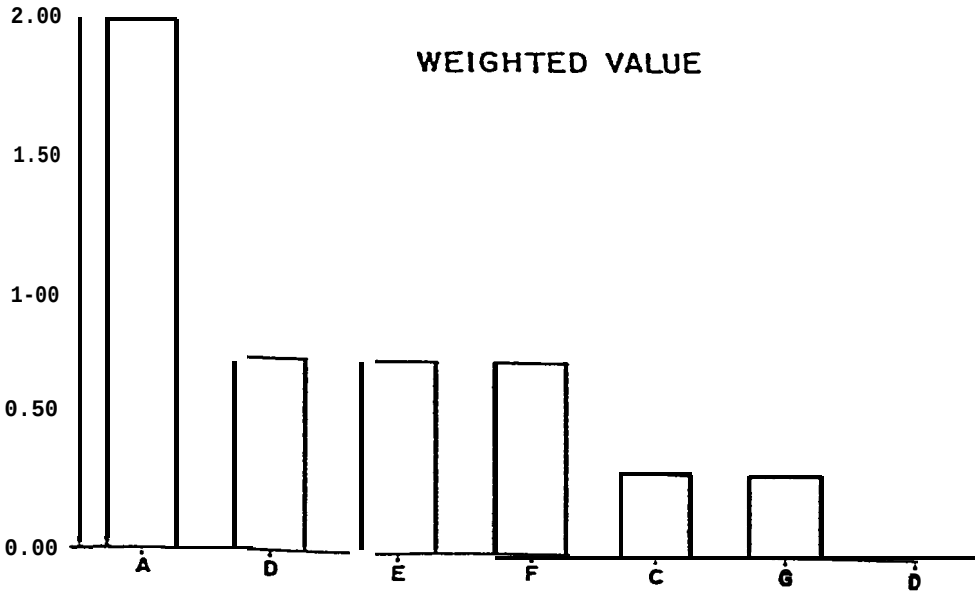
   d. Order of chapters should be rearranged _____

   e. Kinds of-drawings for Owner's approval should be reduced _____

   f. Kinds of vendors' drawings for Owner's approval should be reduced _____

   g" Others (specify below)

      _____
      _____
      _____



A: DESCRIPTION SHOULD BE MORE SIMPLIFIED
B: DESCRIPTION SHOULD BE MORE DETAILED
C: KINDS OF TECHNICAL DOCUMENTS ACCOMPANYING THE CONTRACT SHOULD BE REDUCED
D: ORDER OF CHAPTERS SHOULD BE REARRANGED
E: KINDS OF DRAWINGS FOR OWNER'S APPROVAL SHOULD BE REDUCED
F: KINDS OF VENDOR'S DRAWINGS FOR OWNER'S APPROVAL SHOULD BE REDUCED
G: OTHERS

4. If revision is required, in what priority order should it be revised among the following items? (number priority order)

   a. Description should be more simplified _____

      Chapters to be simplified _____ _____

   b. Description should be more detailed _____

      Chapters to be detailed _____

   c. Kinds of technical documents accompanying the Contract should be reduced _____

      Documents to be exempted (specify below)

      _____

      _____

      _____

   d. Order of chapters should be rearranged _____

   e. Kinds of drawings for Owner's approval should be reduced _____

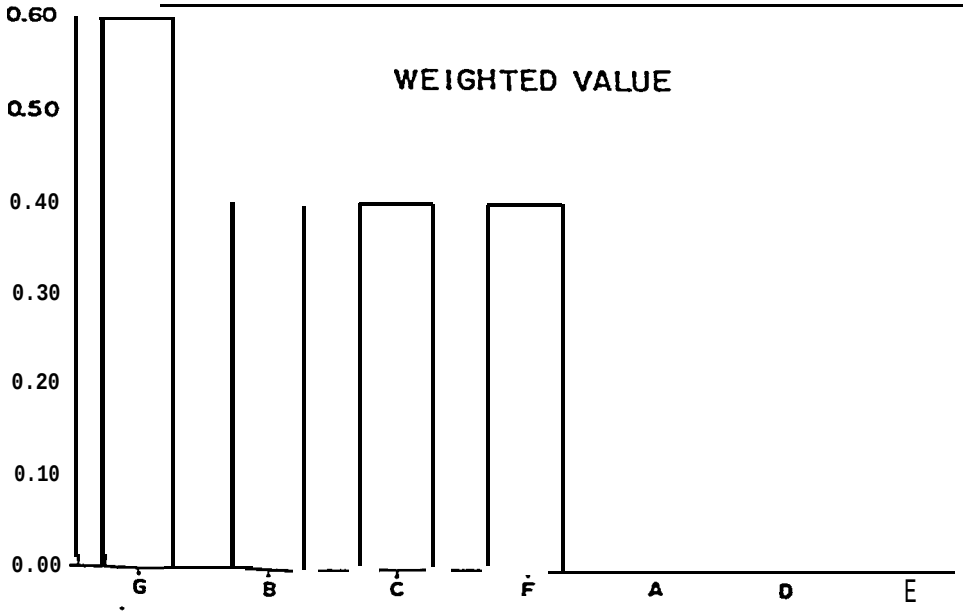
   f. Kinds of vendors' drawings for Owner's approval should be reduced _____

   g. Others (specify below)

      _____

      _____

      _____



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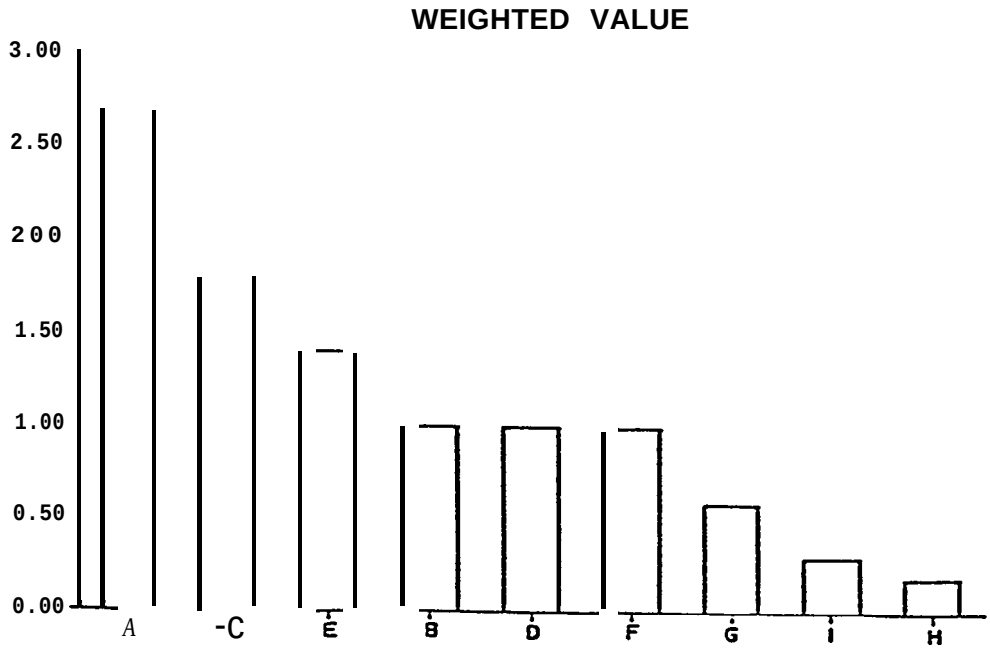
C: KINDS OF TECHNICAL DOCUMENTS ACCOMPANYING THE CONTRACT SHOULD BE REDUCED
D: ORDER OF CHAPTERS SHOULD BE REARRANGED
E: KINDS OF DRAWINGS FOR OWNER'S APPROVAL SHOULD BE REDUCED
F: KINDS OF VENDOR'S DRAWINGS FOR OWNER'S APPROVAL SNOULD BE REDUCED
G. OTHERS

c. Troubles experienced during ship's construction:

If you have experienced any trouble during the ship's construction, ycur answers to the following questions are requested:

1. Who is your opponent party which is involved in the dispute? (number in the orderof trouble's occurred)

   a. Ship Owner, including its representative(s) such as field inspector(s) _____
   b. MARAD _____
   c. U.S. Coast Guard _____
   d. Classification Society (ABS, etc.) _____
   e. Consulting & Engineering Firm _____
   f. Machinery Vendor _____
   g. Subcontractor _____
   h. Trade Union _____
   i. Others (specify) _____

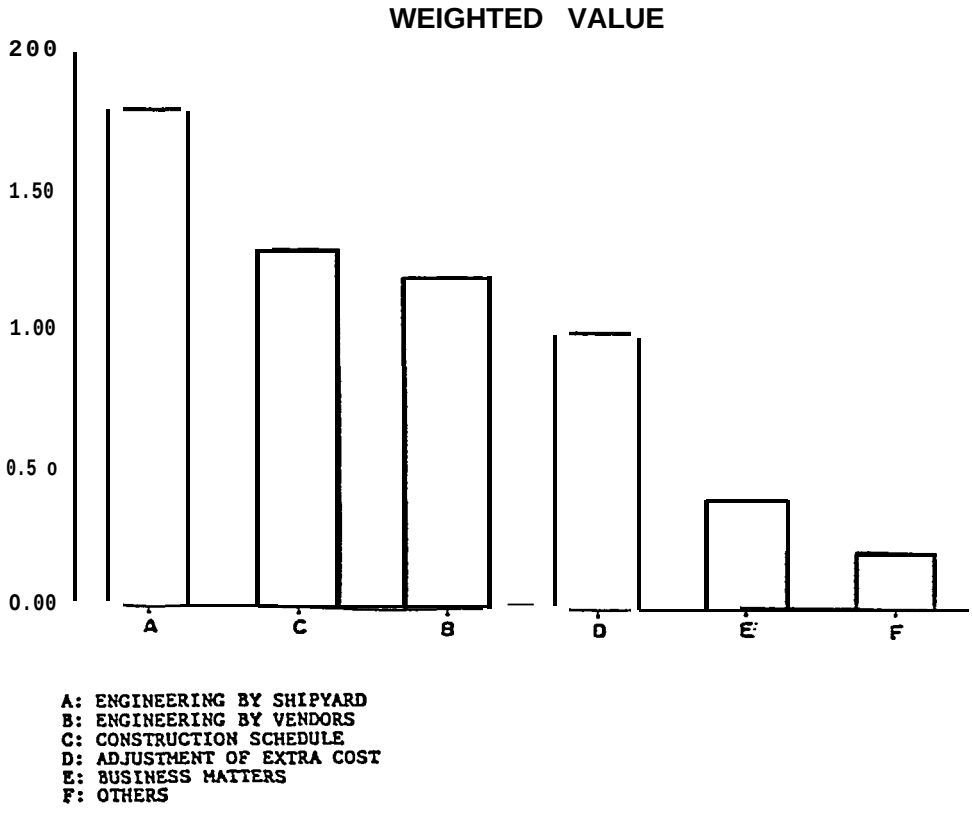


A: SHIP OWNER, INCLUDING ITS REPRESENTATIVE. SUCH AS FIELD INSPECTORS
B: MARAD
C: U.S. COAST GUARD
D: CLASSIFICATION SOCIETY
E: CONSULTING & ENGINEERING FIRM
F: MACHINERY VENDOR
G: SUBCONTRACTOR
H: TRADE UNION
I: OTHERS

c. Troubles experienced during ship's construction:

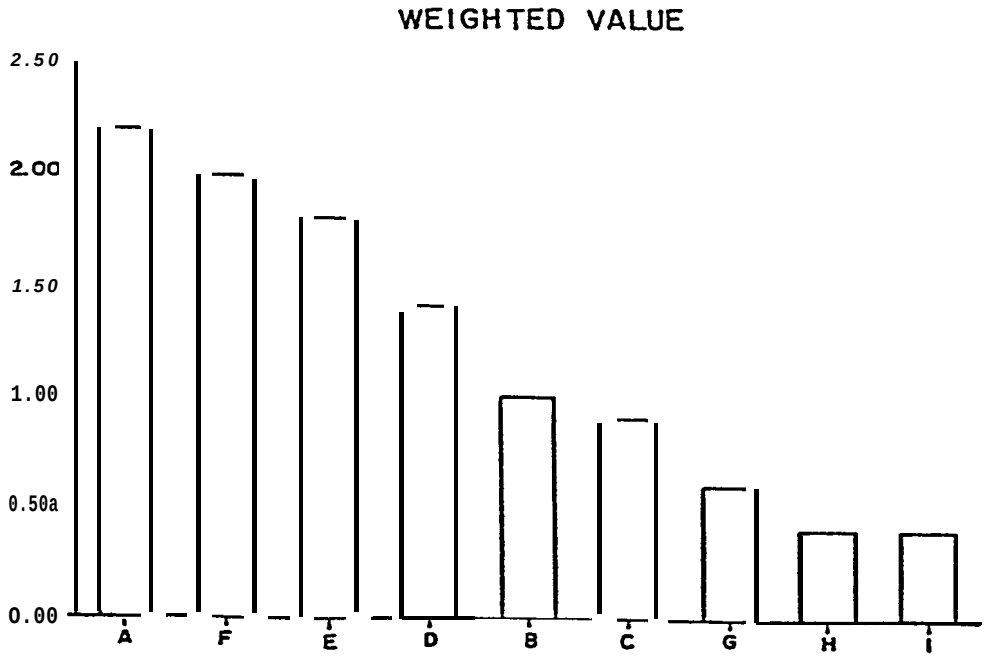
If you have experienced any trouble during the ship's construction, your answers to the following questions are requested:

1. From viewpoint of your side, for what items was the shipyard responsible?
   a. Engineering by shipyard _____
   b. Engineering by vendors _____
   c. Construction Schedule _____
   d. Adjustment of Extra Cost _____
   e. Business matters _____
   f. Others (specify] _____



2. What kind of matters were the troubles related to:
(number in order of occurrence)

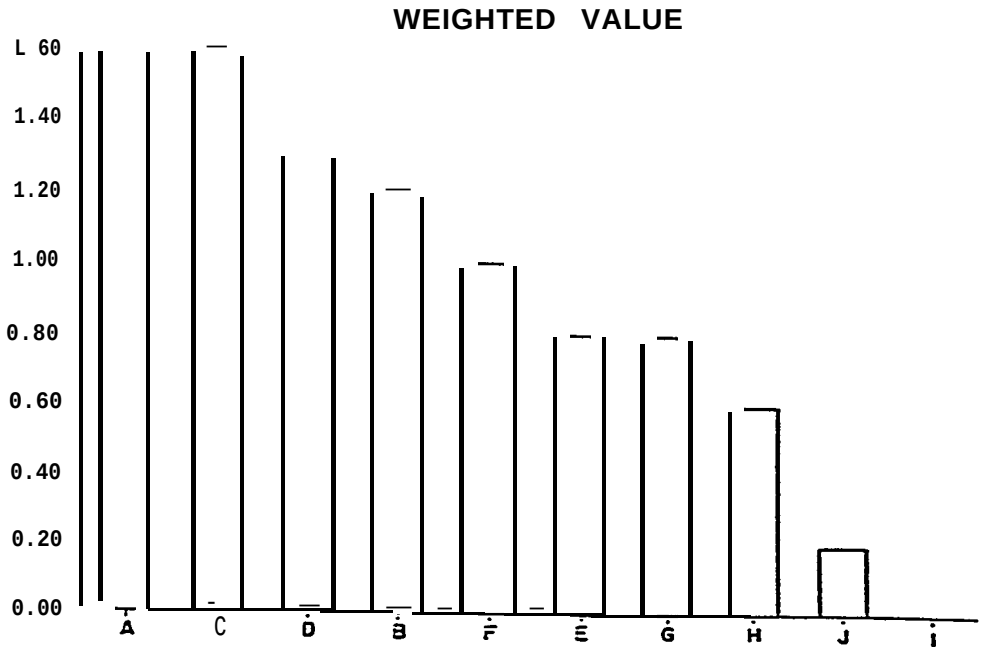
a. Engineering or Design _____
b. Shipyard's practice _____
c. Quality of workmanship _____
d. Painting _____
e. Approval procedure (drawings & construction) _____
f. Inspection _____
g. Performance test of machinery _____
h. Sea Trial _____
i. Others (specify) _____



A: ENGINEERING OR DESIGN
B: SHIPYARD'S PRACTICE
C: QUALITY OF WORKMANSHIP
D: PAINTING
E: APPROVAL PROCEDURE
F: INSPECTION
G: PERFORMANCE TEST OF MACHINERY
H: SEA TRIAL
I: OTHERS

2. What kind of matters were the troubles related to:
(number in order of occurrence)

a. Engineering or Design _____
b. Shipyard's practice _____
c. Quality of workananship _____
d. Painting _____
e. Approval procedure (drawings & construction) _____
f. Inspection _____
g. Performance test of machinery _____
h. Sea Trial _____
i. Human related matters _____
j. Others (specify) _____



A: ENGINEERING OR DESIGN
B: SHIPYARD'S PRACTICE
C: QUALITY OF WORKMANSHIP
D: PAINTING
E: APPROVAL PROCEDURE
F: INSPECTION
G: PERFORMANCE TEST OF MACHINERY
H: SEA TRIAL
I: HUMAN RELATED MATTERS
J: OTHERS

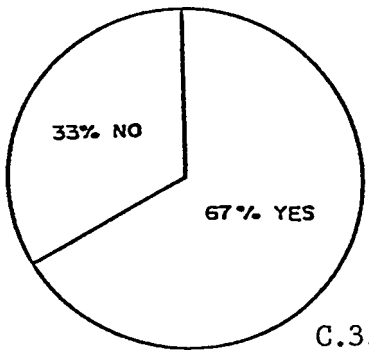
3. For troubles related to engineering or design:

a. Is it usual that the Owner requires many changes or revisions which affect on the construction cost?

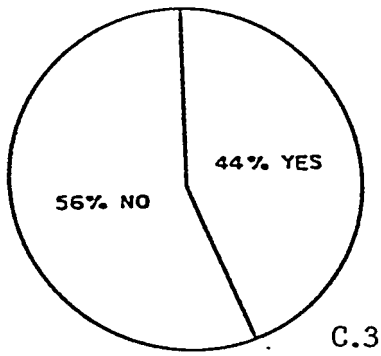
_____ Yes
_____ No

b. Does the Owner require many amendments in the process of any approval though they may not affect on the construction cost?

_____ Yes
_____ No



C.3.a.



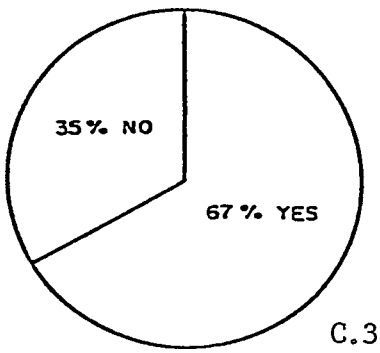
C.3.b.

c. Does it frequently happen that the Owner fails to return approved drawings within the agreed reviewal period?

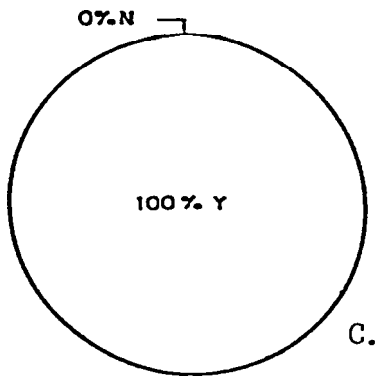
_____ Yes
_____ No

d. In case the contract plans were supplied by the Owner, have you experienced any trouble due to your insufficient understanding or misunderstanding of the plans?

_____ Yes
_____ No



C.3.C.



C.3.d.

3. For troubles related to engineering or design:

a. Does the shipyard respond quickly to your requirement of design changes or revisions?

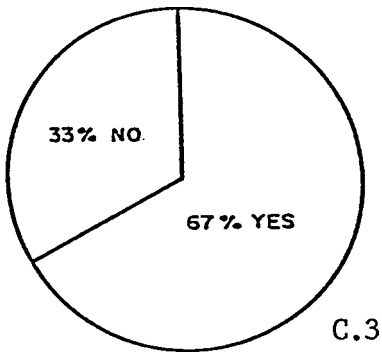
_____ Yes

_____ No

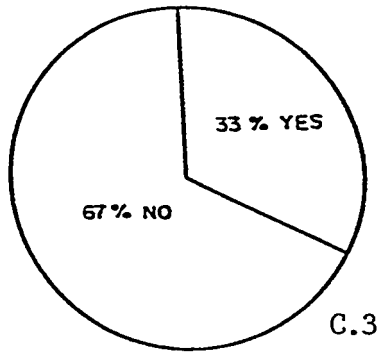
b. Does the shipyard propose many design changes due to their insufficient study or lack of experience?

_____ Yes

_____ No



C.3.a.



C.3.b.

c. Does it frequently happen that the shipyard fails to submitto you approval drawings timely or without giving you enough time for review?

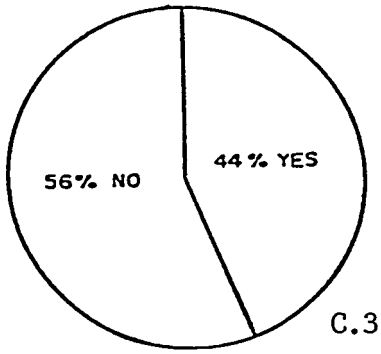
_____ Yes

_____ No

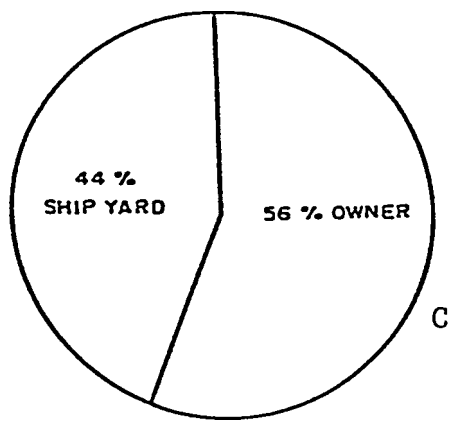
d. For the purpose of minimizing the troubles or disputes during construction who, do you think, should be responsible for furnishing the Contract plans?

_____ Owner

_____ Shipyard



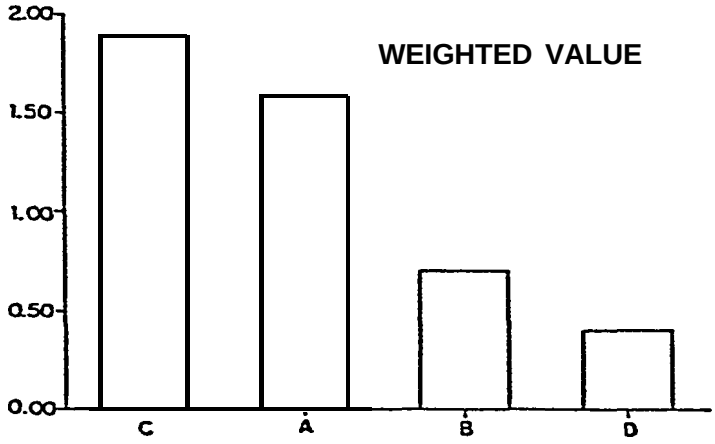
C.3.c.



C.3.d.

If yes, break it down in the order of occurrence:

- Failed to fulfill the basic performance required by the specification _____
- Delayed delivery of machinery _____
- Extra work _____
- Discrepancy in quality criteria between Owner's and yours _____



A: FAILED TO FULFILL THE BASIC PERFORMANCE REQUIRED BY THE SPECIFICATION
B: DELAYED DELIVERY OF MACHINERY
C: EXTRA WORK
D: DISCREPANCY IN QUALITY CRITERIA BETWEEN OWNER'S AND YOURS

e. Drawings for Owner's approval

_____ Present scope of drawings is acceptable

_____ Wish less scope of drawings.

Specify drawings you wish to eliminate:

_____

_____

_____

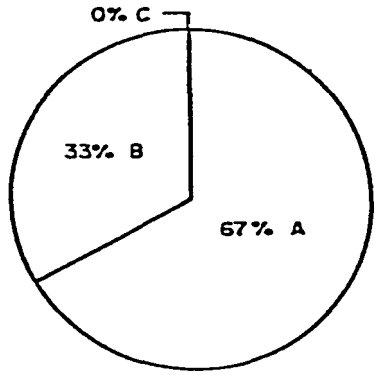
_____ Wish wider scope of drawings.

Specify drawings you wish to add:

_____

_____

_____



A: PRESENT SCOPE OF DRAWINGS IS ACCEPTABLE
B: NAY REDUCE THE SCOPE OF DRAWINGS
C: WISH WIDER SCOPE OF DRAWINGS

e. Drawings for Owner's approval

_____ Present scope of drawings (MARAD Standard) is acceptable

_____ May reduce the scope of drawings if the shipyard is reliable

Specify drawings you may elimimte:

_____

_____

_____

_____

_____

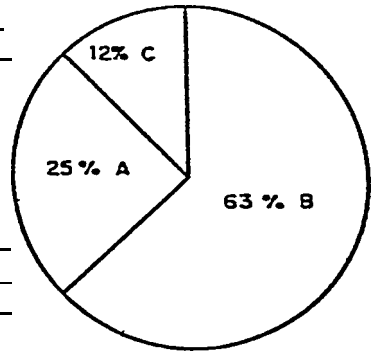
_____ Wish wider scope of drawings

Specify drawings you wish to add:

_____

_____

_____



A: PRESENT SCOPE OF DRAWINGS IS ACCEPTABLE
B: MAY REDUCE THE SCOPE OF DRAWINGS IF THE SHIPYARD IS RELIABLE
C: WISH WIDER SCOPE OF DRAWINGS

f. Reference drawings to be submitted to the Owner

_____ Present scope of drawings is acceptable

_____ May reduce the scope of drawings

Specify drawings you wish to eliminate:

_____

_____

_____

_____ Wish wider scope of drawings

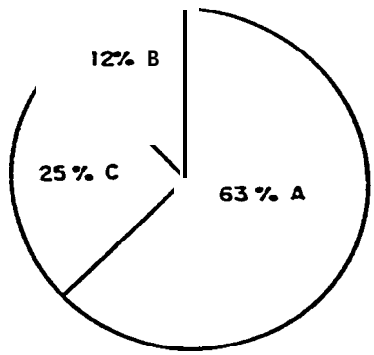
Specify drawings you wish to add:

_____

_____

_____

_____



A: PRESENT SCOPE OF DRAWINGs Is ACCEPTABLE
B: MAY REDUCE THE SCOPE OF DRAWINGS
C: WISH WIDER SCOPE OF DRAWINGS

f. Reference drawings to be submitted to the Owner

_____ Present scope of drawings is acceptable

_____ Wish less scope of drawings

Specify drawings you wish to elimimte:

_____

_____

_____

_____

_____

_____ Wish wider scope of drawings.

Specify drawings you wish to add:

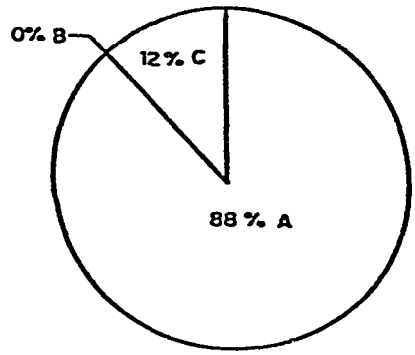
_____

_____

_____

_____

_____



A: PRESENT SCOPE OF DRAWINGS IS ACCEPTABLE
B: MAY REDUCE THE SCOPE OF DRAWINGS IF THE SHIPYARD IS RELIABLE
C: WISH WIDER SCOPE OF DRAWINGS

g. When do you obtain the Owner's approval for the vendors of machinery?

_____ Vendor's list is not furnished for approval

_____ During contract negotiation

_____ As soon as possible after contract

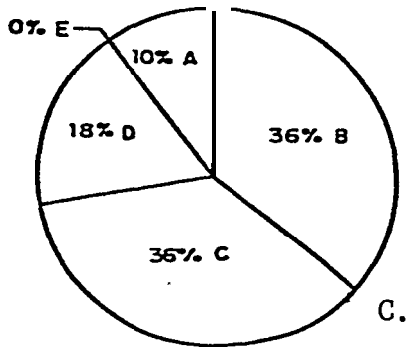
_____ Immediately before ordering the machinery

_____ After ordering machinery

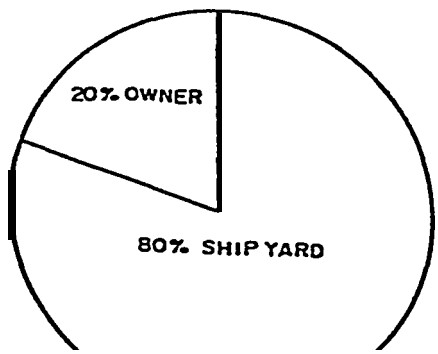
h. Who has the decisive authority to select the vendor?

_____ Shipyard

_____ Owner



C.3.g.

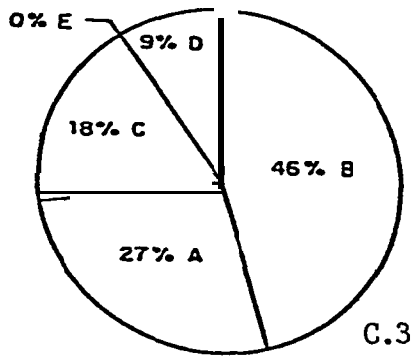


A: VENDOR'S LIST IS NOT FURNISHED FOR APPROVAL
B: DURING CONTRACT NEGOTIATION
C: AS SOON AS POSSIBLE AFTER CONTRACT
D: IMMEDIATELY BEFORE ORDERING THE MACHINERY
E: AFTER ORDERING MACHINERY

g. When do you obtain the List of machinery vendors for your approval from the shipyard?

_____ Vendor's list is not furnished for approval
_____ During contract negotiation
_____ As soon as possible after contract
_____ Immediately before ordering the machinery
_____ After ordering machinery

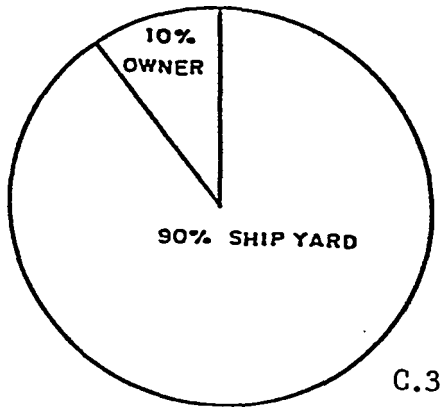
A: VENDOR'S LIST IS NOT FURNISHED FOR APPROVAL
B: DURING CONTRACT NEGOTIATION
C: AS SOON AS POSSIBLE AFTER CONTRACT
D: IMMEDIATELY BEFORE ORDERING THE MACHINERY
E: AFTER ORDERING MACHINERY



C.3.g.

h. Who has the decisive authority to select the vendor after *approval* of the vendors' list?

_____ Shipyard
_____ Owner

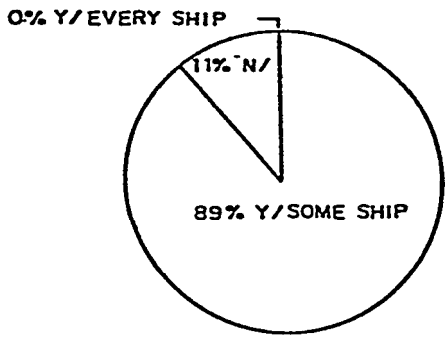


C.3.h.

4. Construction

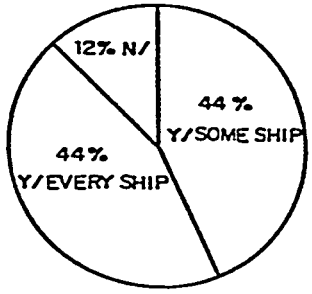
a. Have you experienced any dispute or trouble on your building practices because they had not been discussed and agreed upon during contract negotiation?

_____ Yes, on every ship
_____ Yes, on some ships
_____ No



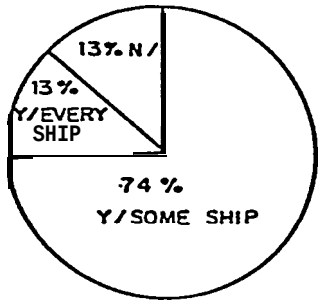
b. Have you experienced any dispute or trouble with the Owner's field inspectors on your building practices?

_____ Yes, on every ship
_____ Yes, on some ships
_____ No



c. Have you experienced any dispute or trouble with the Owner's field inspectors on the quality of your workmanship?

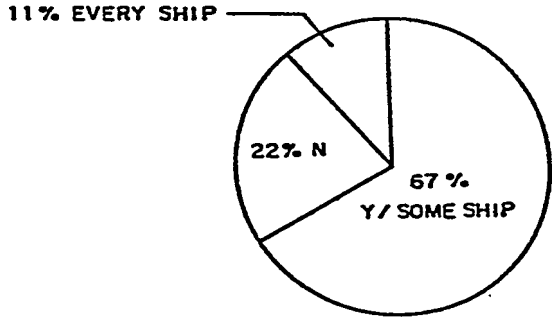
_____ Yes, on every ship
_____ Yes, on some ships
_____ No



4. Construction

a. Have you experience any dispute or trouble on yard's building practices because they had not been discussed and agreed upon during contract negotiation?

_____ Yes, on every ship
_____ Yes, on some ships
_____ No

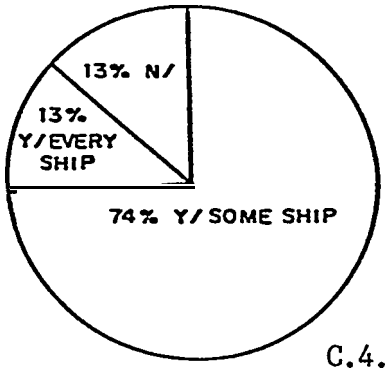


b. Have you experienced any dispute or trouble with the shipyard on its building practices?

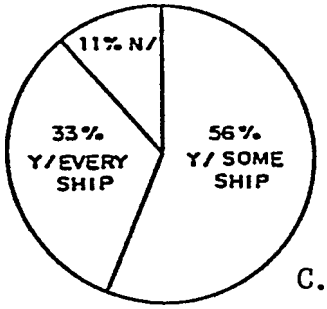
_____ Yes, on every ship
_____ Yes, on some ships
_____ No

c. Have you experienced any dispute or trouble with the shipyard on the quality of its workmanship?

_____ Yes, on every ship
_____ Yes, on some ships
_____ No



C.4.b.



C.4.c.

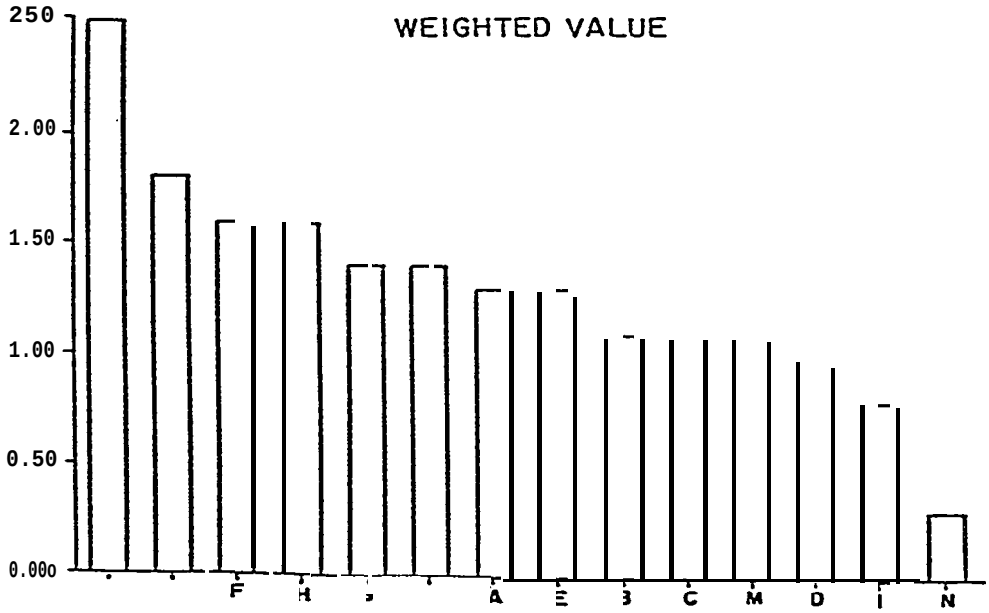
d. What was the nature of those troubles on practices and quality?
(number in the order of occurrence area)

Hull – Fabrication _____
Assembly _____
Erection _____
Welding _____

Outfitting - Deck outfitting _____
Living quarters _____
Machinery outfitting _____
Piping _____
Electric outfitting _____

Painting _____
Poor or delayed vendor drawings _____
Poor quality of delivered machinery _____
On board test/Sea trial _____

Others (specify)_____



A: FABRICATION
B: ASSEMBLY
C: ERECTION
D: WELDING
E: DECK OUTFITTING
F: LIVING QUARTERS
G: MACHINERY OUTFITTING
H: PIPING
I: ELECTRIC OUTFITTING
J: PAINTING
K: POOR OR DELAYED VENDOR DRAWINGS
L: POOR QUALITY OF DELIVERED MACHINERY
M: ON BOARD TEST/SEA TRIAL
N: OTHERS

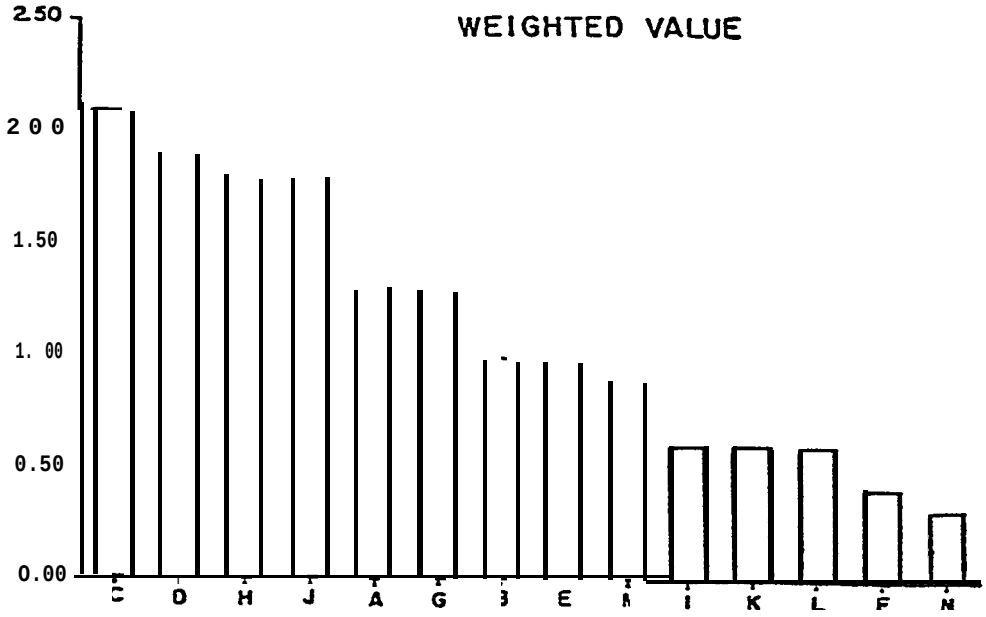
d. What was the nature of those troubles on practices and quality? (nunber in the order of occurrence area)

Hull - Fabrication _____
Assembly _____
Erection _____
Welding _____

Outfitting - Deck outfitting _____
Living quarters _____
Machinery outfitting _____
Piping _____
Electric outfitting _____

Painting _____
Poor or delayed vendor drawings _____
Poor quality of delivered machinery _____
On board test/Sea trial _____

Others (specify)_____ _____



A: FABRICATION
B: ASSEMBLY
C: ERECTION
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E: DECK OUTFITTING
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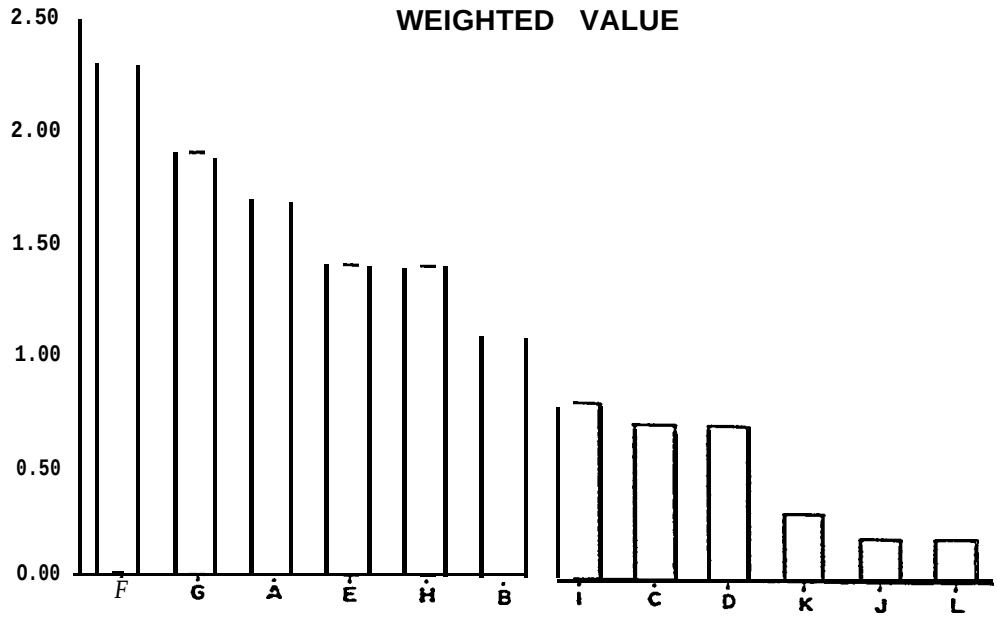
J: PAINTING
K: POOR OR DELAYED VENDOR DRAWINGS
L: POOR QUALITY OF DELIVERED MACHINERY
M: ON BOARD TEST/SEA TRIAL
N: OTHERS

D. Cause of Troubles:

What do you think is the cause of the troubles experienced during construction? (number in the order of occurrence)

a. Incomplete contract negotiation _____
b. Poor engineering or design _____
c. Poor production capability of the shipyard _____
d. Poor quality control of the shipyard _____
e. Poor technique for trouble shooting in terms of persuading the Owner _____
f. Unexpected requirement of Owner _____
g. Unexpected requirement of field inspector _____
h. Unexpected requirement of U.S. Coast Guard _____
i. Unexpected requirement of Classification Society _____
MARAD's Specification _____
j. MARAD's procedure _____
1. Others (specify) _____



A: INCOMPLETE CONTRACT NEGOTIATIONS
B: POOR ENGINEERING OR DESIGN
C: POOR PRODUCTION CAPABILITY OF THE SHIPYARD
D: POOR QUALITY CONTROL OF THE SHIPYARD
E: POOR TECHNIQUE FOR TROUBLE SHOOTING
F: UNEXPECTED REQUIREMENT OF OWNER
G: UNEXPECTED REQUIREMENT OF FIELD INSPECTOR
H: UNEXPECTED REQUIREMENT OF U.S. COAST GUARD
I: UNEXPECTED REQUIREMENT OF CLASSIFICATION SOCIETY
J: MARAD'S SPECIFICATION
K: MARAD'S PROCEDURE
L: OTHERS

D. Cause of Troubles:

What do you think is the cause of the troubles experienced during construction? (nunber in the order of occurrence)

a. Incomplete contract negotiation _____
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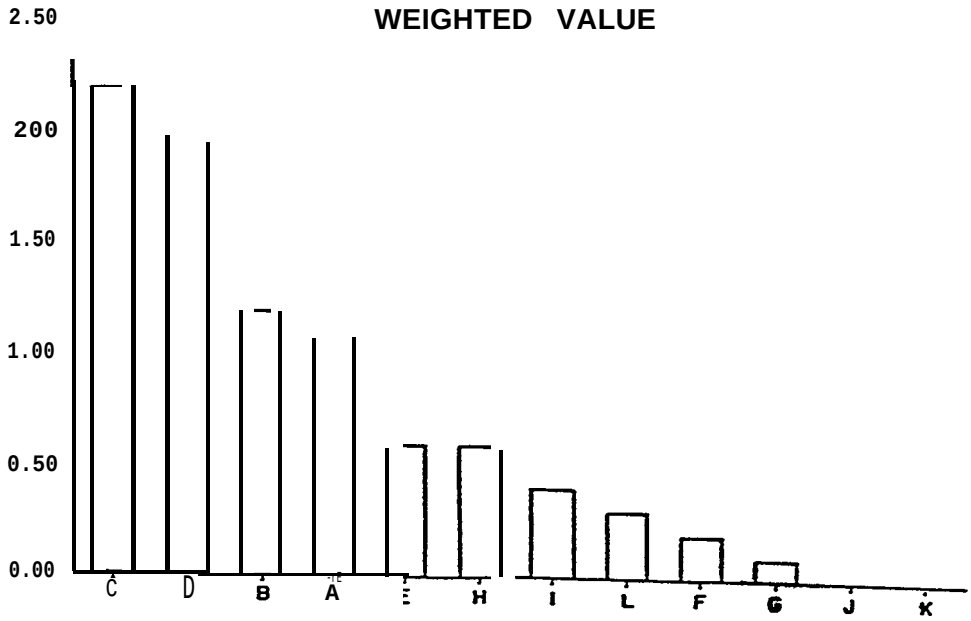
c. Poor production capability of the shipyard _____
d. Poor quality control of the shipyard _____
e. Poor technique for trouble shooting in terms of persuading the _____
f. Unexpected requirement of Owner _____
g. Unexpected requirement of field inspector _____
h. Unexpected requirement of U.S. Coast Guard _____
i. Unexpected requirement of Classification Society _____
j. MARAD's Specification _____
k. MARAD's procedure _____
l. Others (specify) _____



A: INCOMPLETE CONTRACT NEGOTIATIONS
B: POOR ENGINEERING OR DESIGN
C: POOR PRODUCTION CAPABILITY OF THE SHIPYARD
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K: MARAD'S PROCEDURE
L: OTHERS

APPENDIX B

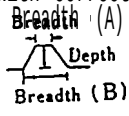
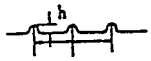
Excerpts from the Japanese Shipbuilding Quality Standard (JSQS) - Hull Part 1982 published by the Research Committee on Steel Shipbuilding, the Society of Naval Architects of Japan:

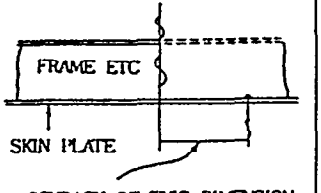
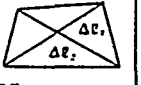
Excerpts from a Shipbuilding Process and Inspection Standard (SPAIS) developed by a Japanese shipbuilder:

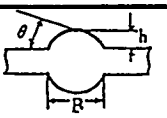
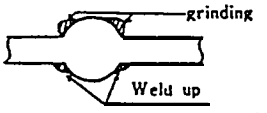
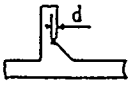
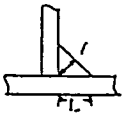
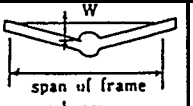
Excerpts from a Quality and Inspection Standard for Ships Painting (QISSP) developed by a Japanese shipbuilder:

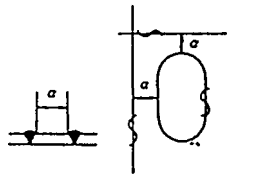
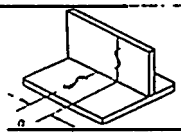
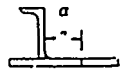
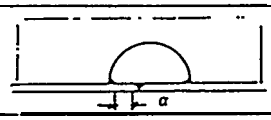
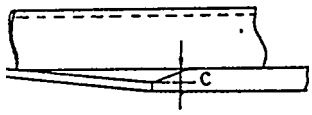
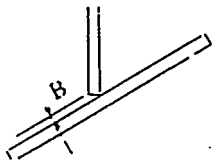
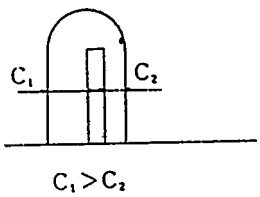
JSQS CONTENTS

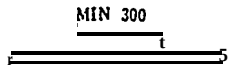
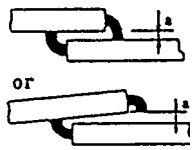
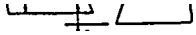
Division I — Fabrication — UNIT : mm

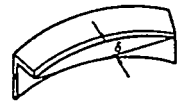
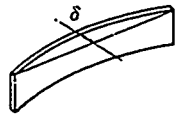
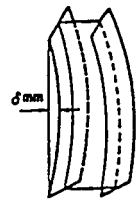
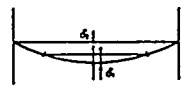
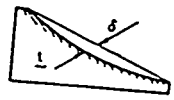
Section	Sub-section	Item	Standard range	Tolerance limits	Remarks
Plates	Corrugated bulkhead	Depth of corrugation.	±3.0	± 6.0	
		Breadth of corrugation, compared with correct ones. 	± 3.0	± 6.0	
			± 3.0	± 6.0	
	Corrugated wall	Pitch of corrugations,	± 6.0	± 9.0	In case where it does not connect with others.
		Depth of corrugation. Compared with correct ones. 	± 2.0 ± 2.5	± 3.0 ± 5.0	In case where it connect: with others.
	Cylindrical structure (mast, post etc)	Diameters 	± D/200 But, Max. ± 5.0	D/150 But,. Max. ± 7.5	
	Curved shell plate	In regard to the check line. (for longitudinal)	± 2.5	± 5.0	
		# (for transverse)	±2.5	± 5.0	
		Gap between shell plate and section template.	± 2.5	± 5.0	
Line heating method	Maximum heating temparature on surface. (HT 50)	Water cooling just after heating	under 650° C		
		Air cooling after heatii	under 900°C		
		In case of moment air cooling and subsequent water cooling after heating	under 900°C (starting ten perature of water cooling to be under		

Division		Sub-assembly			UNIT : mm
Section	Subsection		Standard range	Tolerance limits	Remarks
Accuracy of Dimensions	Flat plate Sub-assembly	Breadth of Sub-assembly	± 4	± 6	Cut. when too long.
		Length of Sub-assembly	± 4	± 6	Cut. when too long.
		Squareness of Sub-assembly	4	8	Measured difference of diagonal length at final marking lines. When the difference is over the limits, correct the final marking line.
		Distortion of Sub-assembly	10	20	Measured on the face of web-beam or girder.
		Deviation of Interior members from skin plating	± 5	± 10	Excluding the case when interior members are connected by lapped joint. 
	Curved plate Sub-assembly	Breadth of Sub-assembly	± 4	± 8	Measured along the girth. Cut. when too long.
		Length of Sub-assembly	± 4	± 8	Cut. when too long.
		Distorsion of Sub-assembly	10	20	Measured on face of web or girder. Correct the final marking line. when the distorsion exceed the limits.
		Squareness of Sub-assembly	10	15	Difference of base line for marking $\delta = d$  or differance of diagonel lengths at marking $\delta = \lvert \Delta\ell_1 - \Delta\ell_2 \rvert$  marking to be ammended
		Deviation of interior members from skin plating	The same as for the flat plate Sub-assembly		
	Plate Block Sub-assembly	Breadth of each panel Length of each panel Squareness of each panel Distortion of each panel Distortion of interior members from skin plating	The same as for the flat plate Sub-assembly		

Division		Welding		
ection	Sub-Section	Item	Tolerance limits	Remarks
Shape of bead	Height of reinforcement Breadth of bead Flank angle		 h : not defined B : not defined θ≦90°	 In case where θ is over 90°, it is to be repaired by grinding or welding to make θ≦90°
	Under cut (butt weld)	Skin plate and face plate between 0.6L 外	over 90mm continuous d≦0.5mm	 to be repaired by using fine electrode. (carefully avoid short bead for higher tensile steels)
		Others	d≦0.8mm	
	Under cut (fillet weld)		 d≦0.8mm	
	Leg length	Compared with Correct ones (L, ℓ)	 L : Leg length ℓ : Throat depth ≧0.9L ≧0.9ℓ	In case where it is over tolerance limits, weld up over it. (carefully avoid short bead for higher tensile steels)
Distorsion of welding joint	Angular distorsion of welding joint.	Skin plate between 0.6L 外	 W≦6mm	In case where it is over tolerance limits, it is to be repaired by line heating or to be re-welded after cutting and re-fitting.
		Fore and Aft shell plating and Trans verse strength member	W≦7mm	
		Others	W≦8mm	
Short bead Tack welding bead Repair welding bead		Higher tensile steel (50kg/mm² class) Cast steel	≧50mm	In case where short bead is used unavoidablly, preheating is necessary at 100 ±25°C. When short bead is made erroneously, remove the bead by grinding, and weld over 50mm after checking root crack or heel crack.
		Grade E of mild steel	≧30mm	
Arc strike		Higher tensile steel (50kg/mm² class) and Grade E steel of mild steel Cast steel Grade E of mild steel	not allowed	In case where arc-strike is made erroneously, one of the following repair method is applied. (1) weld over 50mm bead on the arc-strike. (2) apply post heating at 350 - 650°C (3) remove the hardened zone by grinding.

Division		Alignment and Finishing		UNIT : mm
Section	Subsection	Item	Tolerance limits	Remarks
Minimum distance of weld to adjacent weld or rivet	Butt weld to butt weld		$\alpha \geqq 30$	Detail of the construction is decided in mold loft or appli. cation planning section. in case where it is not described in the approved plan. The numerals of this division indicate final condition.
			$\alpha \geqq 0$	
	Butt weld to fillet weld		$\alpha \geqq 10$ (main structurel) $\alpha \geqq 0$ (Super-structure)	
			$\alpha \geqq 5$	
Gap between members	Gap between plate and stiffening member	Stiffening member located perpendicularly to plate.  when C>3. any following treatment ran he taken. 1)  2)  3) 	$C \leqq 3$	Gap betweem members is to be less than 3 '%. in case where it is inevitable to make flush the plate surface of non-stiffening side.
		Stiffening member located obliquely to plate. [without edge preparation) 	$B \leqq 3$	
	Through piece and tight plate	 $C_1 > C_2$	$C_1 \leqq 3$	

Division		Alignment and Finishing			UNIT : mm
ction	Sub-section	Item	Standard range	Tolerance limits	Remarks
Fitting Accuracy	Gap before Velding	Butt weld (manual welding)  a : Gap	!≦a<3.5	a≦5	① 5<a≦16 After welding with backing strip, remove it and finishing weld after back chipping.  ② 16<a<25 Welding up with edge preparation or partial renew. ③ a>25 Partial renew. 
		Butt weld (automatic welding) 1. Both side submarged arc welding 	)≦a≦0.8	0≦a≦5	In case where it is predicted to be burned through, sealing bead is to be done.
		2. Submerged are weld. ing with manual or CO_1 welding 	)≦a≦3.5	0≦a≦5	In case where a is over 5mm, see manual welding.
		3. One side submarged are welding with flux cupper backing or flux backing 	0≦a≦1.0	0≦a≦3	In case where it is predicted to be burned through, sealing bead is to be done.
		4 .One side submarged arc welding with fiber asbestos backing 	0≦a≦4	0≦a≦7	In case where it is predicted to be burned through, it is adjusted by scattering of metal powder or sealing bead is to be done.
		Lap weld 	a≦2	a≦3	① 3<a≦5 Increased leg length Rule Ieg+a ② a>5 Re-fitting
	Alignment of butt joint  a a : Difference t : Thickness (thinner plate)	Strength member		a≦0.15t (max 3)	a> O.15t or a>3 Refitting
		Others		a≦0.2t (max 3	a> 0.2t or a> 3 Re-fitting

Division		Deformation		UNIT : mm	
Section	Sub-section	Item	Standard Range	Tolerance limits	Remarks
Miscellaneous	Distorsion of deep girder and trans (at the part of upper edge and flange)	Length of span	5	8	
	Distorsion of longl. trans frame, beam and stiffner. (at the part of flange)	$\ell \leqq 1{,}000$	5	8	
		$1{,}000 < \ell < 3{,}500$	$3+\frac{2\ell}{1000}$	$6+\frac{2\ell}{1000}$	
		$\ell \geqq 3{,}500$	10	13	
	Distorsion of H pillar between decks.		4	6	
	Distorsion of cross tie.	Distorsion of fore and aft direction. δ_1 (cross tie only)	6	10	
		Distorsion of fore and aft direction. δ_2 (cross tie + trans web)	12	16	
	Distorsion of tripping bkt and Small stiffener with web plate.	Distorsion at the part of free edge.		$\frac{t}{}$	
	Distorsion of face plate.		$a=2+\frac{b}{100}$	$a=5+\frac{b}{100}$	

SPAIS CONTENTS

9. INSPECTION

2. HULL CONSTRUCTION PROCESS

The Vessel shall be constructed and outfitted in accordance with the Builder's building process as specified hereunder.

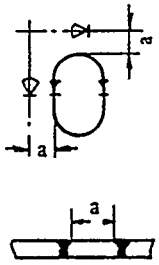
2.1 Hull Structural Construction

2.1.1 Assembly Block

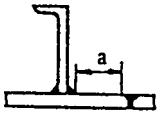
In general, steel construction blocks of suitable sizes shall be assembled in the workshop and then erected on the building berth and/or the building dock.

2.1.2 Distance between Adjacent Welding Beads

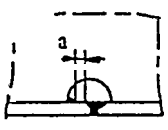
A. Distance between Adjacent Butt Welds

Item	Allowable Limit mm	Remarks
1. 	a ≧ 30	
2. 	b ≧ 0	No restriction for the location of butt.

B. Distance between Butt Weld and Fillet Weld

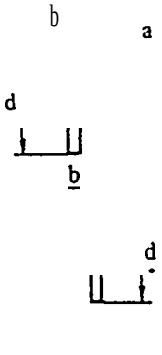
Item	Allowable Limit mm	Remarks
	a ≧ 10 (Main structures) a ≧ 0 (Superstructures)	Overlap of welds shall be allowed where the members are arranged diagonal to the butts in fore & aft constructions and in superstructures.

C. Distance between Butt Weld and its Scallop Welding

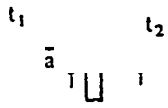
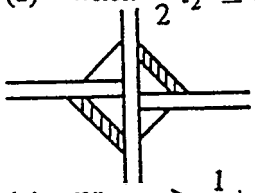
Item	Allowable Limit mm	Remarks
	$a \geqq 5$	

2.1.3 Accuracy in Hull Construction

A. Size of Built-up Sections

Item	Allowable Limit mm	Remarks
	$a \leqq \pm(3 + \frac{b}{100})$ d = nominal depth ±2 b ≧ nominal breadth –2	

B. Mis-alignment in Fillet Connections

item	Allowable Limit mm	Remarks
	1. Longitudinal members within 0.6L U and principal transverse supporting members: $a \leqq \frac{1}{3} t_2$	When "a" exceeds the, allowable limit, following treatment shall be applied: 1. For main structures: (a) When $\frac{1}{2} t_2 \geqq a > \frac{1}{2} t_2$  Weld leg length shall be increased by 10%. (b) When $a > \frac{1}{2} t_2$: The member shall be re-aligned
t_1 & t_2: thickness of members. a: misalignment where $t_1 \geqq t_2$	2. Others: $a \leqq \frac{1}{2} t_2$:	2. For Others: When $a > \frac{1}{2} t_2$: The member shall be realigned.

4.9 Air Conditioning Test

Airconditioning tests, such as tests for heating in summer or cooling in winter where the tests by automatic temperature control device cannot be carried out due to prevailing temperature conditions, shall be tested manually to ensure satisfactory operation of the machinery and equipment.

4.10 Foam Fire Extinguishing Test

In view of "[international convention for prevention of pollution of the sea", the substitutional test (sea" water discharging etc.) for the above shall be carried out without discharging foam.

5. MACHINERY FITTING PROCESS

5.1 Shafting and Propeller

5.1.1 Main Shaft Alignment

Shaft centering shall. be carried out at following conditions.

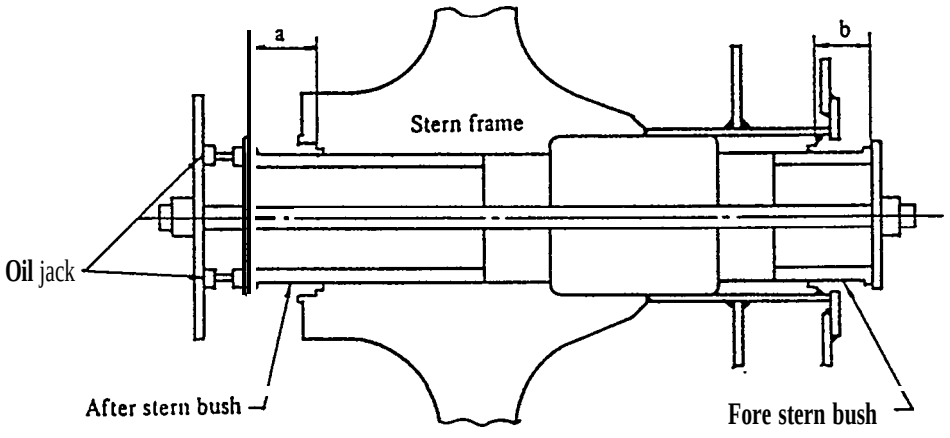
A. Hull construction works, excepting minor internal welding, below the lower engine flat level and aft of the engine room forward bulkhead is completed and hydraulic tests for cooling space or void spaces are finished but the internal inspection of the hull construction mentioned above may not necessarily be finished.

B. For hull construction works below the steering engine flat, the surface welding for butts and seams of skin plates are finished.

c. Other hull construction works not mentioned above, shall be carried out in accordance with the Builder's construction schedule, irrespective of the shaft alignment.

5.1.2 Fitting of Stem Bush

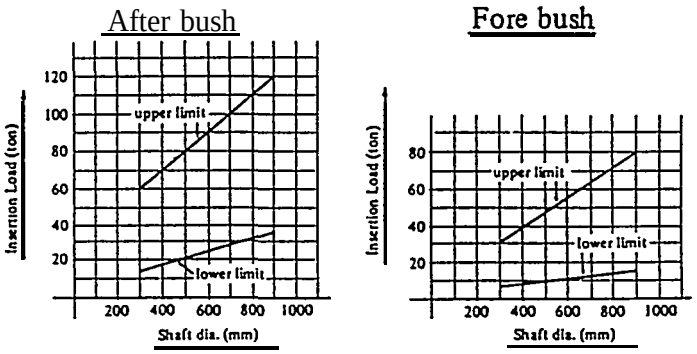
The installation of stern bush shall be carried out by using hydraulic oil jack as shown below example figure.



Pressure of the hydraulic power and load shall be measured during measurement of the distance of insertion.

The measurement shall be recorded at the last 100mm (b) drive for forward bush and at the last 250mm (a) drive for the aft ward bush.

The bushes shall be inserted into the stern tube by the following insertion loads.



5.1.3 Contact Conditions of The Propeller Shaft and The Propeller

The key shall be fitted to the propeller shaft and blue paint shall be painted on the shaft to check contact condition of the cone-part of the shaft and the propeller boss.

Then the propeller shaft shall be removed from the boss, and the contacting surface of the cone-part shall be checked.

Acceptable contact condition of the cone-part shall be determined by cross contact of at least 4 points per 25 millimeter square.

s. 1.4 Fitting of Propeller

The fitting stroke shall be decided considering temperatures of the propeller boss and shaft cone just before fitting.

5.1.5 Tightening-up of PropelIer Nut

The propeller nut shall be tightened up to following final torque.

Shaft dia. D (mm)	Torque (ton-m)
$300 \leqq D < 500$	$5 \sim 10$
$500 \leqq D < 700$	$10 \sim 15$
700 and above	$15 \sim 20$

5.1.6 Tightness Test of OiI Seal

A. After installing the seals on the fore and aft part of the stern bearing and flushing, the oil shall be supplied to the stern bearing and the head tank up to the normal level corresponding to the full loaded condition, and then the level shall be maintained for at least 4 hours to check the leakage.

B. The bottom plugs of the seals shall be detached and the tightness of the seals shall be checked.

5.1.7 Connection of The Shaft

A. The reamer bolts and holes shall be checked to confirm the coincidence with the drawings by measuring its dimensions at the shaft couplings.

B. Reamer bolts and holes shall be painted with Moly-coat or equal, and then fitted together by using the hydraulic jack with a force of 3~20 tons or by other suitable methods, such as chilled bolt fitting and hammering.

5.2 Main Diesel Engine & Appurtenant Equipment

5.2.1 Force Fitting of Holding-Down Reamer Bolts

Reamer bolts and holes shall be painted with Moly coat or equal, and then the bolts shall be forced into the holes by using the hydraulic jack with a force of 1.5 – 15 tons or by other suitable methods such as chiIled bolt fitting or hammering.

5.2.2 Installation of Main Engine

A. Hammering check shall be carried out to confirm that the chock liners are fitted in good condition, or that foundation boil ts are well tightened, and also acceptable clearance of the chock liner shall be confirmed by the feeler gauge of 4/ 100mm thickness that it does not enter more than 10mm.

B. The deflection of crankshaft shall be measured by turning the crankshaft ahead using the turning gear if necessary.

The record of the deflections shall be compared with that taken at the cold condition after assembling, and the deflection should not exceed the following allowable limits recommended by the engine manufacturer.

8. PAINTING PROCESS

8.1 GeneraI

Painting work shall basically follow the Builder's standard process as described hereon as well as the Q. I.S.S.P. (lH1 Quality & Inspection Standard for Ship's Painting) and shall also follow the paint manufacturer's recommendation.

In general, painting work shall be proceeded in accordance with the Builder's schedule which is prepared and based on the Contract Specifications.

8.2 .Surface Preparation

8.2.1 Standard of De-rusting

Refer to Q. I.S,S.P.. Article 2.1

8.2.2 Standard of Surface Cleaning

Refer to Q. I.S.S.P. Article 2.2.

8.3 Hull Block Painting

After finishing the hull block construction works, coating shall be applied. Whenever the surface of the hull block is fully or partially cleaned, the coating shall be applied to the cleaned surface in good time before it becomes rusted.

Outfitting works on the hull block, may be carried out before or after application of the coating, whichever suitable for the construction schedule.

8.4 Correction of slight Damages or Defects

Slight damages or defects, which have been miss detected at block inspection and found after surface preparation etc., shall be marked and left without treating and the whole other surfaces shall be applied with the first coating, and after that, such damages or defects shall be treated by means of welding, chipping and/or grinding and then touched up with paint.

8.5 Finishing of Free Edges of Steel and WeIded Beads

In principle, free edges of steel members, such as those formed by gas cutting and/or welded beads shall not be finished by chipping and/or grinding if it is for painting purpose only.

However, the parts such as badly irregular beads and spatters which the Builder considers it necessary to grind off, shall be treated in accordance with the surface preparation shown in Photographic Standard Nos. 16, 17, 18,19 of the IHI Q. I.S.S.P.

8.6 Painting for Fittings Manufactured by Subcontractors

In general, fittings which are manufactured by subcontractor shall be applied with 1 or 2 coats of anti-corrosive paint and/or finish-coated at the subcontractor's, and then embarked on board the vessel.

8.7 Film Thickness

8.7.1 Measuring Points of Film Thickness

Refer to Q. I.S.S.P. Article 2.1

8.7.2 Instruments for Measurement of Film Thickness

Refer to Q. I.S.S.P. Article 2.1

8.7.3 Measurement Method

Refer to Q. I.S.S.P. Article 2.1

8.8 Surface of Final Coat

Refer to Q. I.S.S.P. Article 2.2

8.9 Inspection items Subject to Attendance. of The Buyer's Supervisors

Refer to Q. I. S.S.P. Article 3.1 & 3.2

QUALITY & INSPECTION STANDARD

FOR SHIPS PAINTING

(Q I S S P)

Contents

1 Quality and Inspection Standard of Surface Preparation

1.1 Quality and inspection standard of de-rusting

1.1.1 Scope

This standard shall be applied inspection of de-resting of steel surface before respective application of shop primer, the first coating and the subsequent coatings.

Note: Shop primer is paint to be applied to steel materials before fabrication to prevent them temporary from rusting during necessary processing thereof.

1.1.2 Standard grade of de-rusting

(Photographic standards are attached at the end of this book.)

(1) Before application of shop primer

Symbol of the grade of de-rusting	ISP-A		ISP-B	
Treatment	Shot blast cleaning	Sand blast cleaning	Shot blast cleaning	Pickling
Photographic Standard of de-rusting grade	No. 1	No. 2	No. 3	No. 4
Application	Where inorganic zinc paints shall be used or where epoxy resin paints shall be applied to C. O.T., B.W.T. and the external parts.		Where epoxy resin paints shall be applied to parts other than C. O.T., B.W.T. and the external parts, or where the conventional paints includiug oleoresinous synthetic paints and chlorinated rubber paints, etc. shall be applied.	
Corresponding to S1S	Approximately BSa 2½		Approximately	

Note: 1. The external parts mean the outside of shell, the exposed parts of deck and superstructure.
2. Respective designations of S1S 055900-1967 corresponding to 1111 Photographic standards are described herein.

(2) Before application of the first coat

Symbol of the grade of de-rusting		lSC-A	ISC-B	ICC-A	ICC-B
Treatment		Sand blast cleaning	Disc sanding and power brushing	Disc sanding and/or power brushing	power brushing
&hotographic standard of de-rusting grade	De-rusting of the parts of shop primer damaged by buring	No. 5	No. 6 No. 9	No. 7 No. 10	No. 8 No. 11
	De-rusting of the parts of shop primer damaged by re-rusting	No. 12	No. 13	No. 14	No. 15
	De-rusting of the beads & the near parts of welding	No. 16	No. 17	NO. 1 8	No. 19
	De-rusting of the parts of no treatment or miss-coat ing	No. 20	No. 21	No. 22	No. 23
Application		Where inorganic zinc paints shall be“used.	Where epoxy resin paints shall be used to C. O.T., B.W.T. and the external parts.	Where the conventional paints including oleoresinous synthetic paints, and chlorinated rubber paints, etc. shall be applied mainly to the external parts, and where epoxy resin paints shall be applied to parts other than C. O.T., B.W.T. and the external parts.	where the conventional paints including oleoresinous synthetic paints and chlorinated rubber paints, etc. shall be used mainly to the internal parts
Corresponding to SIS		Approximately BSa 2½	Approximately CSt3, BSt3	Between CSt 2 & CSt3 Between BS t 2 & B S t 3	Approximately CSt 2, BSt 3

Note: 1. Photo No. 9, 10 and 11 show effect of burning to steel material coated with zinc epoxy primer.
2. The meaning of the external parts is the same as (1) Note 1.
The internal parts mean all sorts of tanks excluding C.O.T. and B.W.T., engine room, pump room, tank tops, bilges, holds, inside of living quarters including stores, coffcrdams, chain lockers and void spaces.
3. As to corresponding designations of S1S, see (1) Note 2.

3 Standard of Items for the Attendance of Inspectors

3.1 Scope

This standard shall be applied to the attendance of Buyer's inspectors for respective location and inspection item and also for builder's inspection.

3.2 Attendance ofinspectors

Attendance of the Buyer's and/or builder's inspectors for inspection shall be performed in accordance with undermentioned standard.

Explanation of symbols:

o markk shows required attendance of Buyer's inspectors.

A mark shows builder's inspection.

3.2.1 Where inorganic zinc paints shall be applied and where epoxy resin paints shall be applied to C. O. T., B.W.T. and the external parts.

Standard of items for the attendance of inspectors

Inspection item / Location	Surface preparation	Finish			Paint film thickness
		Before removal of scaffolding	' Before lining insulation fitting	After final coating	
Bottom Shell (*1)	A			△○	△
Side shell	△			△	△
Exposed parts of upper deck	A			A	△
Exposed parts of superstructure	A			A	
C.O.T.	△	△○		△○	△
B.W.T.	△	△○		△○	△
Holds	A	A	A		
Fittings: Mast, Post, Hatch cover	A			A	
Fittings: 0ther small fittings				△	
Steel materials to be coated with shop primer (*2)	A				

Note: * 1 Sea-chests are to be inspected by the buyer's inspector before being closed.

* 2 Inspection will be made by random selection including check of steel materials after shop primer coating.

APPENDIX C

Proposed Changes to Maritime Administration Standard Specifications

GENERAL COMMENTS

1. Most parts of the specifications are too detailed, leaving little flexibility for applying alternatives of equal function and quality. Requirements should be kept to a minimum in order to allow selection of materials regularly available from suppliers' catalogs and/or to permit employment of shipyard standard practices.

2. The terms "best quality" and "best workmanship" should be avoided as they are generalities, not specifications, and they are used as excuses by buyers to demand the 'highest grades" available.

3. Grouping specifications into "General Provisions", "Hull Specifications", "Machinery Specifications" and "Electrical Specifications", is popular worldwide and more convenient. See Appendix D.

4. Specifications for one system or machine should be consolidated in one section rather than being distributed throughout various sections; see Appendix D.

5. Specifications should include more production requirements, such as: shipyard standards/practices, production processes, and inspection/testing standards in order to prevent conflicts during production,

6. MIL/MarAd/Federal specifications should be comparable to commercial standards. All requirements should be based on non-subsidized construction contracts. In other words all requirements related to CDS should be deleted.

7. Avoid expensive materials, such as monel, which are difficult to obtain in commercial markets. Employ materials popularly used worldwide.

MarAd's Specification			Proposal	Reason
Sec.	No.	Title		
–	–	INDEX (Pages I thru XXVII)	Delete	Preparation of the index is quite time consuming and less important.
1	3	Principal Characteristics (Page 1-2)	Delete the following: - Displacement - Light ship weight	These are the shipyard's private data, and need not be disclosed. The shipyard is only responsible to guarantee the deadweight capacity.
1	3	Principle Characteristics	Add the following: - General description of the ship's features (See text, Page 24) - Cargo hold/tank capacities - Number of containers loaded - Camber, sheer - Complements - Trial speed, including draft conditions, engine rating - Service speed, with sea margin % - Type of main engine ratings at MCR and NOR	To grasp the ship's features and characteristics at a glance.
1	5	Laws, Classification, Rules, Regulations, (Page 1-3)	Itemize required certificates and its issuer	To clarify delivery documents. Special attention required for foreign ships.
1	6	Contract Plans and Guidance Plans (Page 1-4)	Delete the following as Contract/ Guidance Plans: - Midship Section - Lines Plan - Machinery Arrangement - Heat Balance - Arrangement of Accommodation	Although preliminary plans, sketches or reference data are required for pre-contract negotiations, final plans should be submitted as "approval plans" after contract when detail engineering has been completed.

MarAd's Specification			Proposal	Reason
Sec.	No.	Title		
1	6	(Continued)		
			- Cargo Handling - Piping Diagrams - Electric One-Line Diagrams - HVAC Equipment List and Diagrams - Scantling Plans - Shafting Arrangement - Capacity Plan - Intact Trim & Stability Plan - Damaged Stability Calculations - Electric Load Analysis	It is time consuming and costly to prepare these plans before contract.
1	7	Weight & Center of Gravity (Page 1-5)	Delete, Instead, the definition of "Lightship Weight" to determine the "deadweight" should be defined.	Not required for commercial contracts. Total KG can be accurately estimated from previous data or type ship. Calculation of weight and C.G. based upon structural and system breakdown will require detail drawings which are usually unavailable at pre-contract stage.
1	9	Model Tests and Ship Performance Predictions (Page 1-7)	Model Test should not be mandatorily required. If required, this should be the owner's option at extra cost.	Accurate estimation of ship's speed could be obtained by computer analysis based upon test data of various hull forms.
1	10	Models and Mockups (Page 1-8)	Model test or mockups should not be mandatorily required. The necessity of model tests or mockups should be determined by the shipyard at their own responsibility.	The shipyard is responsible for the performance of the system.

MarAd's Specification			Proposal	Reason
Sec.	No.	Title		
1	15	Material and Workmanship (Page 1-10)	Delete design conditions for roll, pitch, list, trim, etc.	Marine standard machinery and equipment will meet these requirements, even though not specified.
			Detail specifications of grease nipples, etc., could be deleted	The words " - - - for marine use" or "- - -of marine standard" will be sufficient enough.
1	16	Hull Protection during Outfitting Period (Page 1-12)	The protection system should not be mandatorily required.	The duration of launching to delivery, water conditions, etc., should be taken into consideration in determining the necessity of under water protection.
1	17	Launching and Drydocking (Page 1-12)	Exemption of drydocking should be determined based upon the cleanliness of the under water hull irrespective of its duration in the water	The shipyard should be responsible to deliver the ship with a clean hull to assure that the trial results assimilate the design conditions, and deliver the ship free of fouling.
2	1	General (Page 2-1)	Add general requirements, if any, for structural design (See Text Page 41), e.g., - Alternate cargo hold loading - Ice Strengthening, Class A	To identify basic design conditions for structural design
2	6	Stern Frame & Rudder Horn (Page 2-2)	Delete 3rd paragraph, i.e.: "Leading edge of the rudder horn... by a superimposed and easily renewable plate..."	Not required by ABS. Costly structure.

MarAd's Specification			Proposal	Reason
Sec.	No.	Title		
2	7	Rudder & Carrier (Page 2-2)	o 1st Paragraph: delete "The leading edge of the rudder...by a super-imposed and easily renewable plate." o Add: Rudder area ratio, i.e., $\frac{\text{Rudder Area}}{\text{Lpp x load draft}}$	Not required by ABS. Costly structure. Criterion for rudder design.
2	17	Decks	Last line - delete: "...prior to application of any paint...watertightness has been completed."	Different test processes will be required for Zone-Outfitting and Zone-Painting methods.
4	3	(c) Watertight & Weathertight Doors (Page 4-3)	Scuff plates on tops and edges of sills could be either stainless steel or aluminum alloy.	Less expensive.
4	3	(j) Refrigeration Space Doors (Page 4-3, 4)	o Add: "or other suitable material" after "fiberglass construction" o Hardware material should not be limited	Leave flexibility in selection of material. Ditto.
4	4	Cargo Hatch Covers (Pages 4-4 thru 4-8)	Too detailed. Should only specify: - Type of hatch covers - Operation system for opening/closing - Design load	Details of design should be left flexible so that hatch covers having equivalent functions could be selected among hatch cover manufacturer's standard designs.

MarAd's Specification			Proposal	Reason
Sec.	No	Title		
4	5	Access Hatches (Page 4-8)	Counterbalance devices (spring or counterweight) could be deleted for small hatches.	Less expensive.
5	1	(c) Windows (Page 5-1)	Wheel house windows need not be "sloped aft at bottom".	Some are vertical and some are sloped forward depending upon the owner's choice.
5	2	Window Wipers (Page 5-1)	Alternative use of "center-motor type clear view screen" should be added.	More popular and trouble free.
5	3	Ladders & Stairways (a) General (Page 5-1)	Formla: ZR + 6/7T = 600mn should be deleted.	
			Minimum slope should be specified instead of maximum slope of 50°.	Ladders which are too steep wouldbe hazardous.
5	3	(b) Accommodation Ladders	Material should not be limited to aluminum. Galvanized steel ladders may be applied for small ships.	Flexibility in selection of material.
6	2-1	Gratings, etc. (Pages 6-1 thru 6-4)	MIL specs, MA specs shouldbe converted to commercial standards.	Materials available in commercial market should be used to reduce the price
7	1	Insulation Linings & Battens (Page 7-1)	Ditto.	Ditto.

MarAd's Specification			Proposal	Reason
Sec.	No	Title		
7	1	(a) Insulation Material (Page 7-1)	Instantaneous resin foam should be added as alternative.	Used for refrigerated stores.
7	4	Insulation, Refrigerated spaces (a) General (Page7-2) (d) Thickness of Insulation (Page 7-3)	Specific thickness of insulation which meet temperature requirements should be specified.	Could be standardized. Easier for engineering and estimating reposes.
		(e) Decks (Page 7-3) (f) Bulkheads, Lining & Overhead Ceilings (Page 7-3, 4)	Too detailed. Leave flexibility for alternatives	Couldbe standardized.
8	1	Kingposts, Booms, Masts, Davits (Pages 8-1 thru 8-2)	Cargo derrick booms are becoming obsolete. Specifications for deck cranes should be specified as first priority.	Jpdating of cargo handling system.
9	1	Running Rigging, Blocks (Page 9-1)	Specifications for wires and block for deck cranes should be referred to manufacturer's standard.	Jse of manufacturer's standard.

MarAd's Specification			Proposal	Reason
Sec.	No.	Title		
10	3	Anchors (Page 10-1)	Lightweight type should not be mandated .	Left to owne'ss choice
10	4	Chains (Page 10-1)	Type of detachable links (kenter-type or shackle type) should be specified.	Difference in cost
10	5	Chain Stoppers (Page 10-2)	Types other than riding tongue type should be specified as alternative.	Difference in cost
10	6	Hawsers,	Scope of shipyard's supply should be the minimum nmber required by	Extra hawsers and ropes should be furnished by the owner.
	7	Heaving Line (Page 10-2)		
11	9	Sea Chests (Page 11-10)	Alternative material for Monel such as stainless steel should be adopted.	Less expensive
12	2	Air Conditioning, Heating and Ventilation (b) (1) Design Criteria	Temperature conditions for cooling/ heating and other design conditions should be more simplified. Also refer to Text, Page 49.	Allow flexibility so that manufacturer's standard system could be applied.
12	2	(2) Classes of Air Conditioning System (Pages 12-3 thru 12:15)	Only specify recommended principal types of systems, and delete detail specifications. Refer to Text, Page 49.	Adopt manufacturer's standard systems.
12	3	Cargo Hold a. Break Bulk (Pages 12-15, 16)	Mechanical ventilation should not be mandated.	Natural ventilationis mostly applied for dry bulk cargo.

MarAd's Specification			Proposal	Reason
Sec.	No	Title		
12	5	Steam Heating and Air Conditioning Water Systems, etc. (Pages 12-17 thru 12-40	Delete detail specifications. Refer to Text, Page 49	Adopt manufacturer's standard systems and equipment.
13	2	Extinguishing Systems (Pages 13-1 thru 13-3)	Fire extinguishing system for cargo areas of oil tankers and dry cargo vessels should be added for selection of system, e.g., Oil tankers - Foam Bulk/ore carriers - Not required	To identify required system for engineering and estimating purposes.
14	1	Painting & Cementing General (Page 14-1)	Delete paragraphs 3 and 4. Only specify type of paint.	Manufacturer's brand or trade names should not be referred to to allow free competition among paint suppliers
14	1	(Page 14-2)	Delete paragraphs 2, 3, and4	Should allow application of new advanced painting system even without proven history. Laboratoroy test results and other back-up data would suffice evaluation.
14	1	(Page 14-3)	Paragraph 2: Delete	Follow recommendations from paint supplier.
14	1	(Page 14-3)	Paragraphs 3, 4, & 5: Delete MIL Spec. and only state "approved commercial material".	Leave it to paint supplier's recommended paint
14	2	Surface Preparation (Pages 14-4 thru 14-5)	Add: Surface treatment grade for cargo oil tanks applying pure epoxy and inorganic zinc paints.	Follow paint supplier's recommendation

MarAd's Specification			Proposal	Reason
Sec.	No.	Title		
14	2	(a) Cleaning (Page 14-4)	Change brand names of cleaning agents to commercial base generic names .	Leave it to paint supplier's recommendation
14	1-6	(Painting Schedule Table (Pages 14-6 thru 14-14)	Delete paint dry film thickness per coat. Only specify total dry film thickness'.	Thickness per coat may differ depending upon paint suppliers specification
			Surface Preparation: Add touch up grade (SP-)for damaged areas.	Clarify surface treatment method for damaged areas.
14	8	Cathodic Protection (Page 14-15	Specify design conditions for aluminum or zinc anodes, e.g., - Ballasting rate (% per year) - Minimnn current density (_milliamperes per square -Lifetime (-Years)	Identify design conditions.
14	9	Paints and Coatings (Data Sheet) (Pages 14-16, 17)	Delete	Need not be required for commercial contracts
15	1	Navigation Equipment Details of Equipment (Pages 15-1 thru 15-3)	Change MIL specs to commercial standards.	Use of commercial standards
			Add: Other equipment installed in wheel house, e.g., flags, signals, sextant, binoculars, etc.	Identify supply scope

MarAd's Specification			Proposal	Reason
Sec.	No	Title		
16	2	Boats (Page 16-1)	Specify: - Number of boats and type of motor - Capacity - Material (RFP, Aluminum, etc.) - Engine Cooling system (air cooled or water cooled) - Starting of engine (battery)	Identify on Specification instead of referring to Contract Plans.
16	7	Inflatable Liferafts (Page 16-2)	Specify: - Number and location of rafts - Capacity	Ditto
16			Add: Type, numbers of life jackets, life buoys, distress signals, etc.	Identify supply scope
17	4	Commissary Spaces (Pages 17-1 thru 17-6)	Simplify specification of equipment Only specify type, material, and number so that commercial standard equipment could be used. Delete manufacturer and brand names.	Allow flexibility to use commercial standard equipment available in the market. Allow free competition,
18	4	Utility Spaces and Workshops (Pages 18-1 thru 18-3)	Same as above	Same as above
19	.9	Furniture & Furnishings (Pages 19-1 thru 19-12)	Simplify specification for each furniture. Only specify type, material, size and delete MIL and MA specifications so that commercial standards could be used.	Allow flexibility to use commercial standards available in the market.

MarAd's Specification			Proposal	Reason
Sec.	No	Title		
19	16	Electric Fans (Page 19-3)	Delete	Not necessary if mechanical ventilation is provided
20	0	Plumbing Fixtrues & Accessories (Page 20-1)	Delete: "Crane Company, American Standard" and only specify ". ..shall be of standard marine quality."	Allow free competition
		(Pages 20-1 thru 21-6)	Simplify specification. Only specify type, material, size so that commercial standards could be used.	Allow flexibility to use commercial standards available in the market.
21	9	Hardware (Pages 21-1 thru 21-6)	Same as above	Same as above
22		Protective Covers	Delete MIL specs and/or brand names.	Allow free competition
23	1	Miscellaneous Equipment & Stowage, General (Page 23-1)	Paragraph 5, Material of shelves in refrigerated spaces: Galvanized steel or wooden shelves should be allowed.	Less expensive
23	2	Stowage Spaces (Pages 23-2 thru 23-8)	Specify gratings and battens for each store and locker	Identity scopeof furnishing
23	4	Dumbwaiter Car & Unit (Page 23-7	Combine With Section 4, Article 3, Section 81, Article 6 in one section.	Easier to identify complete structure
23	5	Engineer's Platform Hoist Car (Page 23-7)	Combine with Section 81, Article 12 in one section.	Ditto

MarAd's Specification			Proposal	Reason
Sec.	No.	Title		
25	2	Joiner Work& Interior Decoration, General (Pages 25-1 thru 25-4	Change MA and/or Fed. Specs. to commercial standards.	Use of commercial standards available in the market
25	2(1)	Carpets (Page 25-3	Combine with Section 6, Article 7.	Easier to identify
25	3	Decorator Schemes (Pages 25-4 thru 25-9	Delete	Color scheme could be determined after contract by "approval plans".
27	1	Container Stowage & Handling, General (Page 27-1)	-Specify Lashing device for on-deck containers, e.g., by rods.	For engineering and estimting purposes
			-Attach drawing of a typical lashing pattern of on-deck containers.	Ditto
			-Specify container load (weight) on hatch covers.	Identify design load for hatch cover design
			-Specify size of angles for cell guides.	For engineering and estimating purpose
50	1-5	Main&Auxiliary Machinery (Pages 50-1 thru 50-33)	Recommend changing specifications based upon medium-speed diesels to slow-speed diesels.	See Text, Pages 50 thru 54
50	1	General (Page 50-1)	Specify design conditions in Article 1, General.	Ditto
50	2	Power Plant Performance (Page 50-2)	Delete	Could be identified by approval plans
50	4	General Descri tion (Pages 50-2 thru 50-4)	Combine with Article 1 of Section 50	Need not be separated
50	5	List of Machinery (Page 50-29)	Type starting: Add "or battery or air"	Normal practice

MarAd's Specification			Proposal	Reason
Sec.	No.	Title		
50	5	List of Machinery (Pages 50-4 thru 50-33)	-Description is too detailed. Only specify minumum requirements such as type, number, capacity, material, etc., sufficient enough to define the function of the machinery or equipment.	Leave flexibility to allow selection from manufacturer's standard products which satisfy the functional requirements
			-Recommend grouping by type of machinery and equipment instead of by systems, such as the following: - Main Diesel Engine - Shafting & Propeller - Steam Generating Plant - Electric Generators - Pumps - Purifiers - Air Compressors, Fans & Air Reservoirs - Heat Exchangers - Miscellaneous Machinery - Tanks in Engine Room	Easier for estimating and purchasing purposes
50	-	(Fuel Oil Consumption)	Add: Fuel consumption rate for main diesel engine and auxiliary diesel engine, test condition (shop test), fuel oil calorific value.	Identify conditions for fuel consumption measurement.
50	-	(Shop Test)	Add: Procedures of shop test for: - Main diesel engine - Generator engines - Pumps - Purifiers - Air compressors - Fans	Identify test procedures

MarAd's Specification			Proposal	Reason
Sec.	No.	Title		
51	1-14	Main Diesel Engine (Pages 51-1 thru 51-5)	Recommend change of specifications from medium-speed diesel to slow-speed diesel	Recent trend in engine selection
53	1 1	(b) Line Shafting (c) Tail Shaft (Pages 53-1, 2)	Delete details of machinery, fabrication method, etc.	Leave details to shipyard's standard practice.
53	4	Steady bearings (Page 53-3)	Too detailed. Only specify type of bearing, material, structure, etc., sufficient enough for design.	Ditto
53	10	Propeller (Pages 53-5 thru 53-9)	Simplify specification by deleting details of tolerances, bore, etc.	Ditto
55	1	Distilling Plant, General (Pages 15-1, 2)	Monel material could be substituted by stainless steel.	Less expensive
			Delete details of structure and dump valve, etc.	Leave flexibility to use manufacturer's standard equipment
56	1-6	Fuel Oil System (Pages 56-1 thru 56-6)	Only specify minimum requirements. Leave details to engine manufacturer's and shipyards standard practices.	Could be standardized
56	9	Fuel Oil & Diesel Oil Strainers and Filters (Page 56-4)	Material of strainer basket: delete monel.	Stainless steel is less expensive.

MarAd's Specification Sec.	No	Title	Proposal	Reason
57	1-7	Lubricating Oil System (Pages 57-1 thru 57-7)	Only specify minimum requirements; leave details to engine manufacturer's and shipyard's standard practice.	Could be standardized
57	5	Lubricating Oil Purifiers & Heaters (Page 57-4)	Disc material, delete: "...or monel".	Stainless steel is sufficient.
			Delete detail specification of purifier.	Use manufacturer's standard products.
57	6	Strainers (page 57-5)	Basket material: Monel could be substituted by mild steel or stainless steel.	Less expensive
58	1-3	Sea Water Systems, General, Sea Water Engine Cooling System, Auxiliary Sea Water Service System (Pages 58-1, 2)	Details to meet engine manufacturer's requirements and/or shipyard' standard practice.	Could be standardized
58	6	Bilge System (Page 58-3)	'Maine Line" bilge system for cargo holds for dry cargo ships in lieu of "independent line" system should be specified as alternative.	Recent trend
58	8	Strainers (Page 58-3)	Basket material: change monel to mild steel or stainless steel.	Less expensive
59	5	(a) Storage Type Water (Page 59-4)	Last paragraph: Add: "...or stain. less steel" after "o.. steel, resin coated".	Leave flexibility to use manufacturer's standard equipment and/or shipyard's practice.
61	2	Exhaust Gas Boiler (Page 61-1)	3rd Line: Add, "...or, awater tube type". after "...boilerr shell!	Ditto

MarAd's Specification			Proposal	Reason
Sec.	No.	Title		
63	5	Fuel Oil Tank Heating Coils (Page 63-2)	Definition of "day tanks" and "storage tanks" are unclear. Better specifiy as, "double bottom tanks" and "deep tanks".	Clarify definition
			Also specify ratio for "heavy oil" and "diesel oil".	Heating coils are not required for diesel oil tanks.
63	6	Cargo Oil Tank Heating Coils (Page 63-3)	Combine with section 68, Article 5.	Need not be separated
65	1-4	Air Conditioning Refrigeration Equipment (Pages 65-1 thru 65-3)	Cooling system should not be limited to "chilled water circulation" system. Direct expansion system is applied in general.	Leave flexibility to use manufacturer's standard system
66	2	Refrigerated Compartments (Page 66-1)	Specify cubic bolume of each compartment.	Identify design condition
66	3-10	Refrigerating Machinery, Refrigerated Compartment Equipment, Controls, Refrigerant Piping System, Thermometers and Gauges. Ice Cube Maker, Spares. (Pages 66-2 thru 66-7)	Delete detail specification of compressors, condensers, etc. Only specify required capacity and design conditions and leave details to meet manufacturer's standard and/or shipyard's practice.	Leave flexibility to use manufacturer's standard machinery and equipment.
67	1-10	Cargo Refrigeration (Pages 67-1 thru 67-6)	Ditto	Ditto
69	1-5	Cargo Hold Dehumidification System (Pages 69-1 thru 69-4)	Ditto	Ditto

MarAd's Specification			Proposal	Reason
Sec.	No.	Title		
70	1-7	Polution Abatement Systems and Equipment (Pages 70-1 thru 70-7)	Delete whole system	Shipyard is responsible to comply with latest rules and regulations in effect at time of contract.
72	2	Diesel Starting & Ship Service Compressors (Page 72-1)	-Paragraph 1, 3rd line: add "or fresh water cooled" after "air cooled".	Normal practice
			-Delete paragraph 1 (rpm and piston speed).	Leave flexibility to use manufacturer's standard and/or shipyard's practice.
72	3	Control Air Compressor (Page 72-1)	4th line: Add "...or reciprocating type" after "...centrifugal displacement type with water seal".	Ditto
72	4	Air Receiver (Page 72-1)	-Specify number of starts required for starting air receiver.	Identify design condition
			-Air receivers: Coatings should be rust preventive paint instead of galvanized.	Large receivers cannot be galvanized.
73	1	Pumps, General (Page 73-1)	In general, "gland packing seals" should be used as standard instead of "mechanical seals".	Less expensive
		(Page 73-2)	Paragraph 6: delete "a bill of material with ASTM ..."	Bill sheet should be furnished only for those required by the rules and regulations.
73	2	Centrifugal Pumps (c) Materials (Page 73-3 thru 73-5)	Change "S" "K" monel to stainless steel.	Less expensive
			Only specify materials for the following: - Casing - Impeller - Shaft & Shaft Sleeve - Wearing ring Other details should be deleted.	Allow flexibility to use manufacturer's

MarAd's Specification			Proposal	Reason
Sec.	No.	Title		
73	3	Rotary Pumps (Pages 73-5, 6)	Only specify materials for the following: - Casing - Rotor - Shaft	Allow flexibility to use manufacturer's standard products
74	2	System Design (Page 74-1)	Delete paragraphs 2, 3, 4	Leave to shipyard's practice
74	3	Installation (Page 74-3)	Paragraph 3, 4th line: change "Monel" to"Stainless steel"	Less expensive
74	5	Corrosion Precautions (Page 74-5)	-Item (2), change "monel" to "stainless steel" or "bronze", depending upon its use and location -Tabulate material of valves, such as follows: Piping System / Size / Material: Body, Seat / Steam / Pressure Standard (kg/cm2)	Less expensive
74	5	(Page 74-5)	-Delete Items (3), (4)	Leave to shipyard's practice
75	1-3	Insulation - Lagging for Piping & Machinery (Pages 75-1 thru 75-10)	Too detailed. Simplify specification by tabulating as follows: Pipe System / Extent of Insulation / Insulation Material: Pipe, Flange & Valve / Protection Cover: Pipe, Flange & Valve -Change MIL/MA/Fed specs to commercial standard.	Could be standardized and easier to identify Use of commercial standard

MarAd's Specification			Proposal	Reason
Sec.	No.	Title		
76	1	Ship Service Generator Engine(s) (Page 76-1)	- Number of engines should be determined to meet the total generating system requirements considering demands at navigation/arrival-departure/cargo handling/port service conditions.	See Text, pages 50-51, 65-66.
			- Alternatives for using a main engine shaft driven generator should also be specified.	Ditto, recent trend.
		(Page 76-2)	Delete paragraph 1 and substitute the following: - Type of engine - Fuel grade - Cooling system - Material - Accessories	Leave flexibility to use engine manufacturer's standards
76	2	Emergency Generator Engine (Page 76-2)	Delete whole section and substitute as above	Ditto
79	1-5	Ladders, Gratings, Floor Plates, Platforms & Walkways in Machinery Space (Pages 79-1 thru 79-3)	Specify sizes of square bars, round bars, angles, spacing of bars, etc., as "about _____" so that nearest sizes could be used.	Leave it to shipyard's standard practice and/or steel mill standard sizes.
80	2	Engineer's Workshop (Pages 80-1 thru 80-3)	Simplify details of lathe, drill, press, grinder, power hacksaw. Only specify minimum requirements.	Leave flexibility to use commercial standard products available in the market.
80	3	Electrician's Workship (Page 80-3)	Ditto	Ditto
80	6	Welding Equipment (Page 80-4)	Ditto	Ditto

MarAd's Specification			Proposal	Reason
Sec.	No	Title		
80	5	Lifting Gear (Page 80-3)	Specify lifting capacity in ____Tons for overhead cranes	Standardized by engine type
81	1	General, (3) Reduction Gears (Page 81-1)	Gears need not be totally enclosed. Open type with protective cover could be used as standard.	Less expensive
			Delete calculation requirements.	Leave it to manufacturer's standard
81	1	(a) thru (d)	Simply specifications. Only specify minimum requirements.	Ditto
81	)	Steering Gear (Pages 81-6 thru 81-8)	Ditto	Ditto
81	3	Windlass (a) thru (d) (Pages 81-8 thru 81-12)	Same as above Number of windlass should not be limited to one (1) set. Two (2) separate type windlasses (port & starboard) are used for large ships Windlass with hawser drum(s) should be specified as alternative.	-Same as above -Depending upon ship's size and fullness of bow form. -Recent trend
81	3	(b) Duty (Page 81-9	Miniman hoisting load of windlasses should be reduced as follows: - Single type: 30 meters chain weight + 2-anchors - Separate type: 80 meters chain weight + l-anchor - Speed: Min. 9 meters/minute	Standard used by Japanese shipyards

MarAd's Specification			Proposal	Reason
Sec.	N0	Title		
81	4	Boat Winches, (c) (Page 81-12	Motor: Add air-nmtor driven as alternative	Less expensive
81	7	Accommodation Ladder Winches (Page 81-12)	Ditto	Ditto
81	8	Hatch Covers, (a) thru (Pages 81-13 thru 81-15	Operation system should not be limited to hydraulic system. Mechanical system could be used depending upon type of hatch cover	Use operating system in accordance with hatch cover manufacturer's standard.
81	.0	Cargo winches, (a) thru (c) (Pages 81-15 thru 81-17	Electro-hydraulic system should be specified as alternative. Steam winches may be used for oil tankers.	Recent trend When cargo pumps are steam driven
81	13	Bow Thruster (a) thru (d) (Pages 81-18, 19)	Simplify specification. Only specify minimum requirements.	Use manufacturer's standard equipment.
81	14	Constant Tension Mooring Winches (a) thru (e) (Pages 81-19 thru 18-20	Ditto Electro-hydraulic system should be specified as alternative.	-Ditto -Recent trend
81		Cargo Deck Cranes	Electric or Electro-hydraulic cargo deck cranes should be added.	Recent trend for cargo handling system.
86	-1	Spares - Engineering (Pages 86-1, 2)	Recommend consolidating all spares distributed in various sections into this section.	Easier to identify and control

MarAd's Specification			Proposal	Reason
Sec.	No	Title		
88	1	Ship Generators (a) General (Page 88-1)	Leave number of generators open so that it could be determined considering electric power demand at navigation/departure-arriveal /cargo handling/port conditions. Also add alternative specification of main engine shaft driven generator.	
88	1	(b) Construction (Page 88-1)	Dripproof, self-ventilaged type generators should be used as standard. Circulating air cooling type should be specified as alternative.	More popularly used.
			Paragraph 5; add: "Incase the cables descend from the upper side of the generator, watertight cable penetration tubes shall be provided for the cable entry to the terminal housing."	Cables are not always arranged for bottom entry.
88	2	Emergency Generator (Page 88-2)	Starting should not be limited to hydraulic. Battery or air could be used.	Leave to shipyard's practice.
89	1	Switchboard, General (a) Structure (Page 89-1)	Add to paragraph 1: ". ..in case the circuit breakers are not enclosed with non-combustible material" after.''. ..power circuit breaker".	Enclosed circuit breakers do not necessitate separate individual compartments.
		(b) Enclosures (Page 89-1)	Delete Paragraph 4 and 5 (i.e., switchboard lighting and bottom entry	Lighting and entry will depend upon the design condition, and should be determined case by case.

MarAd's Specification			Proposal	Reason
Sec.	No.	Titl		
89	1	(d) Air Circuit Breakers (Pages 89-2,3)	Delete paragraphs 3, 4, & 5 (i.e., molded circuit breaker of plug-in type, and air circuit breaker of drawout type, spaces for spare feeder breaker)	Lighting and entry will depend upon the design condition, and should be determined case by case.
89	4	(b) (3) Battery Charging Panel (Page 89-7)	As alternative; high rate charging and trikle charging, floating charging should be considered.	More economical in some cases
90	2	Electrical Distribution, System Voltages (page90-1	450V/440V system should be added as alternative.	Most ships built outside U.S.A. apply 450v/440v.
90	.2	Catholic Protection (Page 90-7)	Impressed current cathodic protec-tion should be the option of the owner.	Not mandatory
91	3	Controllers (Page 91-3)	Paragraph, delete "At least 15% of the control cubicle area . . . future unit controllers."	Depends upon design condition
94	'— .5	Navigation Equipment (Pages 94-1 thru 94-12)	Some of the quipments specified are not necessarily required for all merchant ships. Add (If fitted) for those not required by regula-tory bodies.	Leave to owner's option
95	'—'	Interior Communications (Pages 95-1 thru 95-20)	Same as above	Same as above
96	1	General (Page 96-1)	Lead-acid 'batteries should be added as alternative.	Used worldwide in merchant ships

MarAd's Specification			Proposal	Reason
Sec.	Ic	Title		
99	-	Centralized Engine Room and Bridge Control (Pages 99-l thru 99-31)	The scope of automation and central ized engine room and bridge control should be optioml to the owner. Recommend list of instrumentation in Matrix table form (See Text, Pages 73, 74)	Leave to owner's option
100	- 1	Planning & Scheduling, Plans, Instruction Books, Etc. (Pages 100-1 thru 100-15)	Delete complete section. (See Text, Pages 28, 37)	Not mandaory for commercial contracts not subsidized by CDS.
101		Tests &Trials (Page 101)	Specify specific test and trial items and procedures. Transfer this section to "General Provisions and/or corresponding sections of each machinery or equipment, e.g., main engine, pumps, etc.	Easy to identify test items and procedures

APPENDIX D

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APPENDIX E: DESIGN CONDITIONS

Main and auxiliary machinery **to** be designed on the basis of the following condition unless otherwise specified hereinafter.

Propelling Machinery

Sea Water Temperature: 32 degrees C
Ambient Temperature: 45 degrees C
Atmospheric pressure: 760mm in mercury column

Shafting and Propeller

The minimum diameter of the shafting to be determined by the requirements of the Classification Society and to have a margin as follows:

About 2mm excess in diameter for intermediate shaft.
About 10% excess in strength for propeller shaft.

The propeller to be designed to absorb normal output of the main engine at about 4.5% higher revolutions than the specified engine revolutions at normal output, under full load and clean bottom condition of the vessel in calm and deep sea.

Steam Generating Plant

Necessary steam to be supplied as follows:

Normal sea service:	Exhaust gas economizer
Maneuvering service:	Auxiliary boiler
Cargo service:	Auxiliary boiler
Port service:	Auxiliary boiler

Electric Generators

For electric generators, refer to Electric Specification.

pumps

Where two or more pumps are provided in one system, excepting ballast pumps and fire and general service pumps, one pump to be sufficient to handle the system and the other to serve as a standby.

The specified capacities and motor outputs of rotary positive-displacement pumps are based on a 0.5 kg/ square centimeter suction lift and the following viscosity:

	For Pump Capacity: C.st.(R.W. No. 1	For Motor Output: C.st.(R.W. No. 1)
Fuel oil booster pump	30 (approx. 125)	170 (approx. 700)
Fuel oil transfer pump	1,000 (approx. 4,000)	1,000 (approx. 4,000)
Lube oil pump	35 (approx. 140)	250 (approx. 1,000)
Lube oil transfer pump	1,000 (approx. 4,000)	1,000 (approx. 4,000)
Stern-tube lubricating pump	60 (approx. 240)	1,000 (approx. 4,000)

Purifiers

The purifiers to be arranged for single-pass purification of diesel oil,, heavy fuel oil and lubricating oil. The specified capacity of purifiers to be on the basis of the following conditions:

	Heavy fuel oil purifier	Diesel oil purifier	Lube oil Purifier
Viscosity (C.S.T.) of oil @ 50 degrees C	340	20	52
Specific gravity @ 15 degrees C	approx. 0.99	approx. 0.90	approx. 0.90
Inlet oil temperature (in degrees C)	approx. 95	approx. 46	approx. 70
Viscosity (C.S.T.) of purification	approx. 34	approx. 24	approx. 24

Heat Exchangers

Heat exchangers to be designed on the basis of the following cleanliness factors and a sea water temperature of 32 degrees C for salt-water cooled heat exchangers.

	Cleanliness factor %
Cooling jacket fresh-water cooler	85
Lubricating oil cooler	85
Generator-engine cooling fresh-water cooler	85
Auxiliary condenser	85
Fuel oil heaters	70
Lube oil heaters	70

LIST OF INSTRUMENTATION

System or Component	Display			Annunciator and Alarm		
	P	T	L	P	T	L
Propulsion Engine Lubricating Oil System -						
Crosshead Oil Inlet	C			Lo		
Main Bearing Oil Inlet	C			Lo		
Thrust Bearing Pads					Hi	
Crankcase Oil Mist Concentration						Hi
Turbo-charger Sump Tank		D				
L. O. Sump tank			C			Lo
Attached Generator Gear Bearing Lube Oil from Cooler					Hi/Lo	
Propulsion Engine Cylinder and Turbocharger Cooling Water System -						
Cylinder Water Inlet	C			Lo		
Cylinder Water Outlet (each cyl.)		D			Hi	
Turbocharger Water Outlet (each turbocharger)					Hi	
Expansion Tank Water						Lo

Abbreviations:
- P: pressure
- T: temperature
- L: liquid level
- C: continuous reading
- D: on-demand reading

LIST OF INSTRUCTIUMENTATION			
System or Component	Display	Annunciator and Alarm	control
Propulsion Engine Control Lever for Speed & Propeller Pitch) Angle	Instrument		
Propulsion Control Location Selector Switch (Bridge/13n~ine Room Local)	G Bridge W - Engine Room O - Local		SS
bridge Control Acknowledge	R - Ac knowledge		
Engine Order Telegraph (incl. wrong direction alarm)	Instrument R - Wrong Direction	Wrong Direction	
Shaft Horsepower Indicator	Instrument		
Propeller Pitch	Instrument	Fault Condition	
Shaft RPM indicator and Counter	Instrument		
Turning Gear Engaged/Disengaged	R - Engaged		
Propulsion Engine Overspeed		Overspeed	
Propulsion Control System Power Supply	W - AvailabIe	Failed	
Steering Control System Power	W - Available	Failed	
Propulsion Engine Auto Shut down		Shut -down	
Controllable Pitch Propeller Control Power		Low	
Propulsion Engine Exhaust Damper Valve	R - By-pass G - Closed		SS - Open/Close/ Automat ic
Damper Position	Percent Open		
Abbreviations: G. W.R.O. : green, white, red orange SS : Selector Switch CS Contol Switch			